U.S. Department of Energy
Office of River Protection
P.O. Box 450
Richland, Washington 99352

REISSUE

03-OSR-0109

Mr. R. F. Naventi, Project Manager
Bechtel National, Inc.
2435 Stevens Center
Richland, Washington 99352

Dear Mr. Naventi:

CONTRACT NO. DE-AC27-01RV14136 – SAFETY EVALUATION REPORT (SER) OF THE HIGH LEVEL WASTE (HLW), LOW ACTIVITY WASTE (LAW), PRETREATMENT (PT), AND BALANCE OF FACILITIES (BOF) CONSTRUCTION AUTHORIZATION REQUEST (CAR) – REVISION 3

References:

1. BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," CCN-027627, dated January 31, 2002.

2. BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," CCN-027638, dated February 19, 2002.

3. BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," CCN-030609, dated May 1, 2002.

This letter forwards the U.S. Department of Energy, Office of River Protection (ORP) SER, Revision 3 (Enclosure) for the Bechtel National, Inc. (BNI) CAR submitted in References 1 through 3. The SER documents the results of the ORP safety review of the preliminary design of the Waste Treatment and Immobilization Plant LAW facility; HLW facility; PT facility; and selected portions of the BOF structures. The results of the SER support issuance of a construction authorization agreement with conditions for the following activities: (1) full construction of the LAW facility; (2) full construction of the HLW facility; (3) full construction of the PT facility; and (4) construction of selected portions of the BOF structures. The Conditions of Acceptance, as summarized in Appendix B of this SER, will be included in separate correspondence, forwarding the Construction Authorization Agreement.

The SER is being made available to the public, the Defense Nuclear Facilities Safety Board, and local stakeholders. The reference to the completed report is: ORP/OSR-2002-18, *Safety Evaluation Report for Waste Treatment and Immobilization Plant (WTP) Construction Authorization*, Revision 3, dated March 17, 2003.

If you have any questions, you may contact me, or your staff may call Robert C. Barr, WTP Safety Regulation Division, (509) 376-7851.

Sincerely,

Roy J. Schepens
Manager

OSR:LFM

Enclosure:
ORP/OSR-2002-18, Rev. 3

Enclosure
03-OSR-0109

ORP/OSR-2002-18
Revision 3

SAFETY EVALUATION REPORT FOR WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) CONSTRUCTION AUTHORIZATION

March 17, 2003

U.S. Department of Energy
Office of River Protection
P.O. Box 450, H6-60
Richland, Washington 99352

PREFACE

As directed by Congress in Section 3139 of the *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999*, the U.S. Department of Energy (DOE) established the Office of River Protection (ORP) at the Hanford Site to manage the River Protection Project (RPP), formerly known as the Tank Waste Remediation System. ORP is responsible for the safe storage, retrieval, treatment, and disposal of the high level nuclear waste stored in the 177 underground tanks at Hanford.

The initial concept for treatment and disposal of the high level wastes at Hanford was to use private industry to design, construct, and operate a Waste Treatment Plant (WTP) to process the waste. The concept was for DOE to enter into a fixed-price contract for the Contractor to build and operate a facility to treat the waste according to DOE specifications. In 1996, DOE selected two contractors to begin design of a WTP to accomplish this mission. In 1998, one of the contractors was eliminated, and design of the WTP was continued. However, in May 2000, DOE chose to terminate the privatization contract and seek new bidders under a different contract strategy. In December 2000, a team led by Bechtel National, Inc. was selected to continue design of the WTP and to subsequently build and commission the WTP.

On January 10, 2001, the U.S. Department of Energy published the revised Nuclear Safety Management rule, 10 CFR 830. This rule, in Subpart B, "Safety Basis Requirements," established specific requirements for the establishment and maintenance of the safety basis of DOE nuclear facilities, including the River Protection Project Waste Treatment Plant (RPP-WTP) project.

A key element of the River Protection Project Waste Treatment Plant (RPP-WTP) is DOE regulation of safety. The regulation is authorized by the document entitled *Policy for Radiological, Nuclear, and Process Safety Regulation of the River Protection Project Waste Treatment Plant Contractor* (DOE/RL-96-25) (referred to as the Policy) and implemented through the document entitled *Memorandum of Agreement for the Execution of Radiological, Nuclear, Process Safety Regulation of the RPP-WTP Contractor* (DOE/RL-96-26) (referred to as the MOA). These two documents provide the basis for the safety regulation of the RPP-WTP at Hanford, including the implementation of regulatory requirements such as 10 CFR 830..

The foundation of both the Policy and the MOA is that the mission of removal and immobilization of the existing large quantities of tank waste by the RPP-WTP Contractor must be accomplished safely, effectively, and efficiently.

The Policy maintains the essential elements of the regulatory program established by DOE in 1996 for the privatization contracts. The MOA clarifies the DOE organizational relationships and responsibilities for safety regulation of the RPP-WTP. The MOA provides a basis for key DOE officials to commit to teamwork in implementing the policy and achieve adequate safety of RPP-WTP activities.

The Policy, the MOA, the RPP-WTP Contract, and the four documents incorporated in the Contract define the essential elements of the regulatory program being executed by the ORP. The four documents incorporated into the Contract (and also in the MOA) are as follows:

> *Concept of the DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*, DOE-96-0005,
>
> *DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*, DOE/RL-96-0003,
>
> *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor*, DOE/RL-96-0006, and
>
> *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for the RPP Waste Treatment Plant Contractor*, DOE/RL-96-0004.

DOE patterned its safety regulation of the RPP-WTP Contractor to be consistent with the concepts and principles of good regulation (reliability, clarity, openness, efficiency, and independence) used by the Nuclear Regulatory Commission (NRC). In addition, the DOE principles of integrated safety management were built into the regulatory program for design, construction, operation, and deactivation of the facility. The regulatory program for nuclear safety permits waste treatment services to occur on a timely, predictable, and stable basis, with attention to safety consistent with that which would occur from safety regulation by an external agency. DOE established a dedicated regulatory organization to be a single point of DOE contact for nuclear safety oversight and approvals for the WTP Contractor. This organization performs nuclear safety review, approval, inspection, and verification activities for ORP using the NRC principles of good regulation while defining how the Contractor shall implement the principles of standards-based integrated safety management.

A key feature of this regulatory process is its definition of how the standards-based integrated safety management principles are implemented to develop a necessary and sufficient set of standards and requirements for the design, construction, operation, and deactivation of the RPP-WTP facility. This process meets the expectations of the DOE necessary and sufficient closure process (subsequently renamed Work Smart Standards process) in DOE Policy 450.3, *Authorizing Use of the Necessary and Sufficient Process for Standards-based Environment, Safety and Health Management*, and is intended to be a DOE approved process under DOE Acquisition Regulations, DEAR 970.5204-2, *Laws, Regulations and DOE Directives*, Section (c). DOE approval of the contractor-derived standards is assigned to the Manager, Office of River Protection.

The RPP-WTP Contractor has direct responsibility for WTP safety. DOE requires the Contractor to integrate safety into work planning and execution. This integrated safety management process emphasizes that the Contractor's direct responsibility for ensuring that safety is an integral part of mission accomplishment. DOE, through its safety regulation and management program, verifies that the Contractor achieves adequate safety by complying with approved safety requirements.

This documents issued is available to the public through the DOE Public Reading Room at the Consolidated Information Center, Washington State University, Room 101L, Richland, Washington.
Copies may be purchased for a duplication fee.

RECORD OF REVISION

Document Title: Safety Evaluation Report for Waste Treatment and Immobilization Plant (WTP) Construction Authorization

Document Number: ORP/OSR-2002-18

Revision Date	Revision Number	Reason for Revision
06/25/02	0	New Issue
08/21/02	1	Add authorization of LAW and HLW walls to grade
11/13/02	2	Add authorization of LAW and HLW full facility, PT pits, tunnels, and basemat and selected portions of BOF
03/17/03	3	Add authorization of PT full facility

EXECUTIVE SUMMARY

This report summarizes the safety evaluation performed on the Construction Authorization Requests (CARs) submitted by Bechtel National, Inc. (BNI), to the U.S. Department of Energy's (DOE's) Office of River Protection (ORP). This safety evaluation report (SER) covers the review and approval of the following six BNI submittals for the Waste Treatment and Immobilization Plant (WTP):

- Partial Construction Authorization Request (PCAR), dated December 10, 2001, for the low-activity waste (LAW) facility, covering installation of forms, rebar, and embedments (FRE) for the basemat; installation of the ground grid connection to the basemat rebar; and placement of the LAW basemat concrete[1]

- PCAR for the high-level waste (HLW) facility, dated December 10, 2001, covering installation of FRE for the basemat, installation of the ground grid connection to the basemat rebar, and placement of the HLW basemat concrete

- CAR, dated January 31, 2002, for early construction authorization of the LAW facility walls-to-grade, covering installation of FRE for structural concrete walls to grade elevation and installation of the walls[2] and authorizing construction for the full LAW facility

- CAR, dated February 19, 2002, for early construction authorization of the HLW facility walls-to-grade, covering installation of FRE for structural concrete walls to grade elevation and installation of the walls and authorizing construction for the full HLW facility

- CAR, dated May 1, 2002, for early construction authorization of Pretreatment (PT) facility subgrade pits, tunnels, and basemat, covering installation of FRE for structural concrete pits, tunnels, and basemat; installation of the pit and tunnel floors and walls, and the basemat; and authorization of construction for the full PT facility

- Balance of Facility (BOF) Preliminary Safety Analysis Report, submitted February 19, 2002, and resubmitted on May 1, 2002, covering authorization to construct portions of the BOF structures and systems.

[1] Subsequent to this request, on February 28, 2002, BNI requested authorization to install FRE for the basemat before completing this safety analysis, using the provision of 10 CFR 830.206(b), "Preliminary documented safety analysis." This request was approved on April 9, 2002.
[2] On July 24, 2002, BNI subsequently requested authorization to install FRE for the LAW and HLW walls to grade before completing the safety analysis. This request was approved on August 7, 2002.

Revision 0 of this SER recommended construction authorization of the basemats for the LAW and HLW facilities. DOE and BNI subsequently signed a Partial Construction Authorization Agreement,[3] authorizing start of partial construction.

Revision 1 of this SER recommended construction authorization of walls to grade for the LAW and HLW facilities. DOE and BNI subsequently signed a Construction Authorization Agreement, authorizing construction of HLW and LAW basemats and walls to grade, subject to the conditions listed in Appendix B of this SER.

Revision 2 of this SER recommended full facility construction authorization of the LAW and HLW facilities; construction authorization of the PT facility pits, tunnels, and basemat; and construction authorization of selected structures and systems in the BOF. DOE and BNI subsequently signed a Construction Authorization Agreement, authorizing these facilities, subject to the conditions listed in Appendix B of the SER.

Revision 3 of this SER incorporates all of the Revisions 0, 1, and 2 reviews of the LAW, HLW, PT, and BOF and adds the following evaluation:

- PT full facility authorization.

Section 5 of the SER contains evaluations of the draft plans submitted with the CAR. The plans were acceptable as draft plans, with deficiencies noted for correction before submittal of the final plans with the Operating Authorization Request.

Section 3.18 of the SER contains evaluations of the Preliminary Fire Hazards Analysis (PFHA) for the WTP facilities. The PFHAs were acceptable as preliminary analyses, with deficiencies noted for correction. Revised PFHAs should be resubmitted to the ORP with the first revision of the PSAR following authorization for full facility construction.

[3] 02-OASR-0289, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "U.S. Department of Energy (DOE) Notice to Proceed with Partial Construction Activities," dated July 9, 2002.

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SAFETY EVALUATION REPORT FOR WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) CONSTRUCTION AUTHORIZATION

1.0 INTRODUCTION

This document summarizes the safety evaluation performed by the U.S. Department of Energy (DOE), Office of River Protection (ORP), of the WTP Contractor's Construction Authorization Requests (CARs). The WTP Contract,[4] Standard 7, Section e(2)(x), permits the Contractor (Bechtel National, Inc. [BNI]) to segment and incrementally submit an authorization request associated with a particular regulatory action, such as construction authorization. BNI proposed several limited construction authorization segments, as shown in Table 1. The ORP agreed to review these submittals and approve them as promptly as possible, if they were adequately supported.

Revision 3 of this safety evaluation report (SER) incorporates all of Revisions 0, 1, and 2 reviews for authorization of low-activity waste (LAW) and high-level waste (HLW) full facility construction; the pretreatment (PT) facility subgrade pits, tunnels, and basemat; and selected portions of the Balance of Facilities (BOF) structure and systems and adds PT full facility construction. For Revision 3, references to the Partial Construction Authorization Request (PCAR) were changed to the Preliminary Safety Analysis Report (PSAR), except where the PCAR contained details not otherwise discussed identically in the PSAR.

A structured process was used to review each segment of the construction authorization based on review guidance prepared by DOE before BNI submitted its CAR. DOE published the review guidance, RL/REG-99-05, *Review Guidance for the Construction Authorization Request (CAR)*, for its reviewers to use in evaluating the CAR.[5] The format and content of RL/REG-99-05 were derived from the U.S. Nuclear Regulatory Commission's (NRC's) Regulatory Guide 3.52, *Standard Format and Content for the Health and Safety Sections of License Applications for Fuel Cycle Facilities*; from NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*; and from BNI's Integrated Safety Management Plan (ISMP), Section 4.2.3.1, "Safety Analysis Reports."

After RL/REG-99-05 was published, BNI proposed in November 2001 that DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, be used for the format and content of its safety analysis reports.[6] DOE approved the use

[4] Contract No. DE-AC27-01RV14136 between the U.S. Department of Energy and Bechtel National, Inc., dated December 11, 2000.
[5] While the OSR provided guidance, alternative descriptions also were acceptable if they were adequately justified.
[6] CCN: 023770, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Approval – Authorization Basis Change Notice ABCN-24590-01-00004, Revision 1, Identification of Safety Analysis Report Format and Content," dated November 2, 2001.

Table 1. BNI Proposals for Sequential Submittal and Approval of CAR Segments

Submittal	Content	Date Submitted to ORP	Date Approved by ORP
LAW PCAR	Installation of forms, rebar, and embedments (FRE) for LAW basemat, connection of the grounding grid, and placement of basemat concrete	11/13/01 Resubmitted 12/10/01	06/27/02
HLW PCAR	Installation of FRE for HLW basemat, connection of the grounding grid, and placement of basemat concrete	12/10/01	06/27/02
LAW CAR and PSAR	Construction of LAW walls to grade and full facility	01/31/02	08/21/02 walls to grade 11/13/02 full facility
HLW CAR and PSAR	Construction of HLW walls to grade and full facility	02/19/02	08/21/02 walls to grade 11/13/02 full facility
PT CAR and PSAR	Construction of PT pits, tunnels, and basemat and full facility	05/01/02	11/13/02 pits, tunnels, and basemat 03/17/03 full facility
BOF CARs and PSAR	Construction of BOF (support facilities). This will come in two separate parts.	BOF-1 02/19/02 BOF-2 05/01/02	11/13/02 BOF-1 and -2
Analytical Laboratory CAR and PSAR	Construction of Analytical Laboratory	Not yet submitted	

of DOE-STD-3009-94 only for the *format* of the safety analysis reports. The content[7] of the safety analysis reports was to remain the same as described in NRC's draft Regulatory Guide 3.52, as previously agreed to by ORP and BNI. When BNI requested a change in format and content, ORP determined that insufficient time existed before submittal of the first PCAR to rewrite RL/REG-99-05 to make the change because its development had taken nearly two years.

On June 29, 2001, BNI notified DOE of its intent to submit to ORP a PCAR for the WTP.[8] The PCAR would request authorization for installing FRE for the HLW and LAW facility basemats. The reviewers agreed that BNI could segment and incrementally submit a CAR.[9] BNI subsequently modified the original submittal dates to accommodate changes to the HLW and PT

[7] 01-OSR-0483, ORP letter from R. J. Barr to R. F. Naventi, BNI, "Partial Approval of Bechtel National Inc. (BNI) Authorization Basis Change Notice, ABCN-24590-01-00004, Rev 1," dated December 5, 2001.
[8] CCN: 021118, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Intent to Submit Partial Construction Authorization Request for the River Protection Project Waste Treatment Plant and Request for Contract Change to Support Proposed Target Schedule," dated June 29, 2001.
[9] 01-OSR-0295, ORP letter from H. L. Boston to R. Naventi, BNI, "Response to Request for Contract Change to Support Proposed Target Schedule and Notification of Intent to Submit Partial Construction Authorization Request," dated August 8, 2001.

facility designs.[10, 11] The requested approval date for installing FRE for both the LAW and HLW basemats was changed to April 10, 2002, with concrete placement of the basemat for both facilities being July 1, 2002. On April 9, 2002, DOE agreed to permit basemat FRE installation for the WTP,[12] and on August 7, 2002, DOE agreed to permit walls to grade FRE installation before the PSAR safety review was completed.[13]

On February 28, 2002, BNI notified ORP of its intent to submit the CAR for the PT facility on May 1, 2002.[14] This submittal would request early authorization to place concrete in subgrade pits and tunnels on September 3, 2002; the basemat on November 4, 2002; and full construction on January 2, 2002. On May 1, 2002, BNI submitted the CAR, requesting early authorization to place concrete in subgrade pits and tunnels on September 17, 2002; basemat on November 4, 2002; and full construction on January 2, 2003.[15] Subsequently, on August 27, 2002, BNI informed ORP that it would not be prepared to place concrete for pits and tunnels until September 24, 2002.[16] This schedule was revised on September 23, 2002, when BNI informed ORP that readiness for concrete placement in the PT would be delayed until late October 2002 (after October 15, 2002).[17] BNI subsequently notified ORP that it would not be ready for full PT facility construction until March 2003. On April 9, 2002, DOE agreed to permit FRE installation for the PT facility.[18]

[10] CCN: 023251, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Changes to Partial Construction Authorization Request (PCAR) Submittal and Requested Authorization Dates," dated October 16, 2001.
[11] CCN: 024681, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Changes to Partial Construction Authorization Request (PCAR) Submittal Dates," dated November 6, 2001.
[12] 02-AMPD-034, ORP letter from W. J. Taylor to R. F. Naventi, BNI, "Bechtel National, Inc.'s (BNI) Request for Authorization to Commence Construction Activities for the Hanford Tank Waste Treatment and Immobilization Plant (WTP) Prior to Preliminary Safety Analysis Report (PSAR) Approval Per 10 Code of Federal Regulations (CFR) 830.206," dated April 9, 2002.
[13] 02-AMPD-106, ORP letter from R. F. Schepens to R. F. Naventi, BNI, "Bechtel National, Inc.'s (BNI) Request for Authorization to Commence Construction Activities for the Hanford Tank Waste Treatment and Immobilization Plant (WTP) Prior to Preliminary Safety Analysis Report (PSAR) Approval Per 10 Code of Federal Regulations (CFR) 830.206 (Forms, Rebar, and Embedments for High Level and Low Level Facility Walls to Grade)," dated August 7, 2002.
[14] CCN: 027643, BNI letter from R. F. Naventi to W. J. Taylor, ORP, "Authorization to Install Forms, Rebar, and Embedments," dated February 28, 2002.
[15] CCN: 030609, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated May 1, 2002.
[16] CCN: 038477, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Contract No. DE-AC27-01RV14136 – Civil Calculations in Support of Pretreatment Facility Early Authorization for Concrete Placement," dated August 27, 2002.
[17] CCN: 039839, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Delay to Engineering Deliverables Supporting Early Concrete Placement in the Pretreatment Facility," dated September 23, 2002.
[18] 02-AMPD-034, ORP letter from W. J. Taylor to R. F. Naventi, BNI, "Bechtel National, Inc.'s (BNI) Request for Authorization to Commence Construction Activities for the Hanford Tank Waste Treatment and Immobilization Plant (WTP) Prior to Preliminary Safety Analysis Report (PSAR) Approval Per 10 Code of Federal Regulations (CFR) 830.206," dated April 9, 2002.

On November 12, 2002, BNI notified ORP of its intent to add the glass former storage facility to the BOF to the authorization agreement.[19] This was done after BNI determined that there were no ITS SSCs in the glass former storage facility. ORP approved the BNI approach to authorize construction of the BOF glass former storage facility on November 21, 2002.[20]

On December 26, 2002, BNI provided ORP information an authorization basis change notice (ABCN), adding the glass former storage facility to Volume V of the PSAR.[21] The letter also stated that a fourth BOF submittal (BOF-4), which had been planned to address construction of the encapsulation facility, waste building, and melter assembly building, would not be submitted because these three facilities were being deferred.

On January 10, 2001, DOE published the revised 10 CFR 830, "Nuclear Safety Management." This rule, in 10 CFR 830.206(b), "Preliminary documented safety analysis," and Subpart B, "Safety Basis Requirements," established specific requirements for establishing and maintaining the safety basis of new DOE nuclear facilities, including the WTP. DOE O 420.1A, *Facility Safety*, was identified as an approved source of design criteria for the facility preliminary documented safety analysis.

Subsequent to implementing the revised 10 CFR 830, ORP verified that the review guidance in RL/REG-99-05 was generally consistent with these requirements, specifically with the requirements of 10 CFR 830.206(b). The details of this verification are in ORP/OSR-2001-06, *Office of Safety Regulation Position on Applying Project-Specific Alternative Safety Analysis Methodology in Lieu of the DOE-STD-3009 Safety Analysis Methodology for the RPP-WTP*. This comparison identified several exceptions where inconsistencies existed. On April 15, 2002,[22] and on August 7, 2002,[23] ORP requested that BNI submit an ABCN to correct these deficiencies. BNI submitted ABCN 24590-WTP-ESH-02-26, *Compliance with DOE O 420.1 Facility Safety*, on September 6, 2002.[24] ORP subsequently approved the ABCN on October 15, 2002.[25]

[19] CCN: 039839, BNI letter from R. F. Naventi to R. J. Schepens, ORP, ""Adding the Balance of Facilities Glass Former Storage Facility to the Hanford Tank Waste Treatment and Immobilization Plant Authorization Agreement," dated November 12, 2002.
[20] 02-OSR-0574, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Approval of Approach to Authorize Construction of the Balance of Facility Glass Former Storage Facility," dated November 21, 2002.
[21] CCN: 035820, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Transmittal for Information: Authorization Basis Change Notice 24590-WTP-ABCN-ESH-02-020, Revision 0, Change to an AB Document – Revision to the BOF PSAR Adding Facilities/Systems to the Construction Authorization Request," dated December 26, 2002.
[22] 02-OSR-0152, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Office of Safety Regulation (OSR) Application of DOE Order 420.1 Requirements to the River Protection Project Waste Treatment Plant (RPP-WTP)," dated April 15, 2002.
[23] 02-OSR-0324, ORP letter from R. F. Schepens to R. F. Naventi, BNI, "Response to Notice Under Federal Acquisition Regulation Part 52.243-7 Notification of Change Clause – Case 15, Pending Number 24590-02-00398," dated August 7, 2002.
[24] CCN: 0404367, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Approval – Authorization Basis Change Notice 24590-WTP-ABCN-ESH-02-026, Revision 0, Compliance with DOE 0 420.1, Facility Safety," dated September 6, 2002.
[25] 02-OSR-0490, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Transmittal for Approval – Authorization Basis Change Notice (ABCN) 24590-WTP-ABCN-ESH-02-026, Rev.0," dated October 15, 2002.

1.1 LAW PCAR Submittal

BNI submitted its LAW PCAR to ORP on November 13, 2001.[26] BNI proposed the following activities for the LAW facility during partial construction: (1) installing FRE for the basemat, (2) installing the ground grid connection to basemat rebar, (3) placing LAW basemat concrete, and (4) placing associated backfill. The submittal consisted of the following two documents:

- 24590-WTP-PSAR-ESH-01-001-01, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information*, Rev. E, November 9, 2001

- 24590-WTP-PSAR-ESH-01-001-03, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; LAW Facility Specific Information*, Rev. F, December 10, 2001.

ORP performed an acceptability review on both documents and notified BNI on November 21, 2001,[27] that the submittal was rejected for detailed review because the documents provided insufficient detailed information concerning the design and hazard evaluations of the LAW building basemat. BNI resubmitted the LAW PCAR on December 10, 2001,[28] and ORP accepted the resubmitted documents for detailed review on December 18, 2001.[29]

The resubmitted documents were reviewed and evaluated against all relevant portions of the approval criteria outlined in RL/REG-99-05. The review team's evaluation, conclusions, and recommendations for the LAW Partial Construction Authorization are included in Sections 3, 4.1, and 7.1.1 of this SER, where the PCAR review considered PCAR details not otherwise discussed identically in the PSAR.

1.2 HLW PCAR Submittal

BNI submitted its HLW PCAR to DOE on December 10, 2001.[30] BNI proposed the following activities for the HLW facility during partial construction: (1) installing FRE for the basemat, (2) installing the ground grid connection to basemat rebar, (3) placing HLW basemat concrete, and (4) placing associated backfill. The submittal consisted of the following document:

[26] CCN: 023767, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the River Protection Project – Waste Treatment Plant," dated November 12, 2001.
[27] 01-OSR-0476, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Acceptability Review for the Low Activity Waste Partial Construction Authorization Request, and Response to Request for Change in Phased Construction Authorization Request Approach," dated November 21, 2001.
[28] CCN: 024490, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated December 10, 2001.
[29] 01-OSR-0512, ORP letter from R.C. Barr to R. F. Naventi, BNI, "Approval of the Partial Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated December 18, 2001.
[30] CCN: 024490, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated December 10, 2001.

- 24590-WTP-PSAR-ESH-01-001-04, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; HLW Facility Specific Information*, Revision D, December 10, 2001.

ORP performed an acceptability review on the HLW PCAR and notified BNI on December 18, 2001,[31] that the submittal was acceptable for detailed review. The HLW PCAR was reviewed and evaluated against all relevant portions of the approval criteria outlined in RL/REG-99-05. The review team's evaluation, conclusions, and recommendations for the HLW Partial Construction Authorization are included in Sections 3, 4.2, and 7.2.1 of this SER, where the PCAR review considered PCAR details not otherwise discussed identically in the PSAR.

1.3 LAW CAR Submittal

BNI submitted its LAW CAR on January 31, 2002.[32] The submittal consisted of the following documents:

- 24590-WTP-PSAR-ESH-01-002-01, *Preliminary Safety Analysis Report to Support Construction Authorization; General Information*, Rev. E, January 31, 2002

- 24590-WTP-PSAR-ESH-01-002-03, *Preliminary Safety Analysis Report to Support Construction Authorization; LAW Facility Specific Information*, Rev. F, January 31, 2002.

ORP performed an acceptability review on both documents and notified BNI on February 14, 2002,[33] that the documents were acceptable for detailed review.

In the submittal, BNI requested early authorization for constructing the LAW walls to grade to mitigate the risk relative to schedule milestones in the BNI Contract and in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement). The request's scope of work for early authorization of the LAW walls to grade was the external and internal structural concrete walls FRE and placement of concrete from the -21 foot elevation up to the nominal grade elevation (+3 foot maximum) for the LAW facility. Both documents were reviewed and evaluated against all relevant portions of the approval criteria outlined in RL/REG-99-05. The review team's evaluation, conclusions, and recommendations for the LAW walls to grade portion of the submittal are presented in Sections 3, 4.1, and 7.1.2 of this SER.

The LAW facility-specific submittal was subsequently reviewed and evaluated for authorization for full facility construction against all relevant portions of the approval criteria outlined in

[31] 01-OSR-0512, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of the Partial Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated December 18, 2001.
[32] CCN: 027627, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated January 31, 2002.
[33] 02-OSR-0061, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Acceptability Review for the Low Activity Waste (LAW) Portion of the Construction Authorization Request (CAR)," dated February 14, 2002.

RL/REG-99-05. The review team's evaluations, conclusions, and recommendations for LAW full facility construction are presented in Sections 3, 4.1, and 7.1.3 of this SER.

1.4 HLW CAR Submittal

BNI submitted its HLW CAR on February 19, 2002.[34] The submittal consisted of the following documents:

- 24590-WTP-PSAR-ESH-01-002-04, *Preliminary Safety Analysis Report to Support Construction Authorization: HLW Facility Specific Information*, Rev. H, February 19, 2002

- 24590-WTP-PSAR-ESH-01-002-05, *Preliminary Safety Analysis Report to Support Construction Authorization: Balance of Facility Specific Information*, Rev. F, February 19, 2002.

ORP performed an acceptability review on both documents and notified BNI on March 5, 2002,[35] that the documents were acceptable for detailed review.

In the submittal, BNI requested early authorization for constructing the HLW walls to grade to mitigate the risk relative to schedule milestones in the BNI Contract and the Tri-Party Agreement. The request's scope of work for early authorization of the HLW walls to grade was the external and internal structural concrete walls FRE and placement of concrete from the -21 foot and -31 foot elevations up to the nominal grade elevation (+3 foot maximum) for the HLW facility. The HLW facility-specific document was reviewed and evaluated against all relevant portions of the approval criteria outlined in RL/REG-99-05. The review team's evaluation, conclusions, and recommendations for the HLW walls to grade portion of the submittal are presented in Sections 3, 4.2, and 7.2.2 of this SER.

The HLW facility-specific submittal was subsequently reviewed and evaluated for full facility construction authorization against all relevant portions of the approval criteria outlined in RL/REG-99-05. The review team's evaluations, conclusions, and recommendations for HLW full facility construction are presented in Sections 3, 4.2, and 7.2.3 of this SER.

1.5 PT CAR Submittal

BNI submitted the PT CAR on May 1, 2002.[36] The submittal included the following document:

[34] CCN: 027638, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated February 19, 2002.
[35] 02-OSR-0092, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Acceptability Reviews Associated with the High Level Waste (HLW) Portion of the Construction Authorization Request (CAR)," dated March 5, 2002.
[36] CCN: 030609, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated May 1, 2002.

- 24590-WTP-PSAR-ESH-01-002-02, *Preliminary Safety Analysis Report to Support Construction Authorization: PT Facility Specific Information*, Rev. E, May 1, 2002.

In the submittal, BNI requested two separate, early authorizations to mitigate the risk relative to schedule milestones in the BNI Contract and Tri-Party Agreement: (1) constructing the PT facility subgrade pits and tunnels and (2) constructing the basemat. The request's scope of work for early authorization of the PT pits and tunnels was the subgrade structural concrete pit and tunnel floor and wall FRE and placement of concrete from the -45-foot elevation up to the nominal grade elevation. The request's scope of work for early authorization of the PT basemat was installing FRE and concrete for the basemat at the nominal grade elevation. The PT facility-specific document was reviewed and evaluated against all relevant portions of the approved criteria outlined in RL/REG-99-05. The review team's evaluation, conclusions, and recommendations for the PT facility are presented in Sections 4.3 and 7.3.1 of this SER.

Other items were provided with the submittal, including the following:

- 24590-WTP-PSAR-ESH-01-001-01, Chapter 6, "Criticality Safety Program"

- 24590-WTP-ABCN-ESH-02-014, *Revision to the BOF PSAR adding facilities/systems to the Construction Authorization Request*, Revision 0, April 30, 2002.

The criticality safety program submittal was reviewed and evaluated against all relevant portions of the approval criteria outlined in RL/REG-99-05, and the evaluation and conclusions are presented in Section 3.6 of this SER.

The revision to the BOF PSAR was reviewed and evaluated against all relevant criteria outlined in RL/REG-99-05, and the review team's evaluations, conclusions, and recommendations are presented in Sections 4.4 and 7.4 of this SER.

2.0 REVIEW PROCESS

This section describes the process for reviewing the various BNI CAR submittals using the approval criteria outlined in RL/REG-99-05. The LAW and HLW PCARs were reviewed before BNI submitted the LAW and HLW PSARs to enable an earlier start for partial construction while providing the project with opportunities to reduce scheduling risks. The walls to grade portions of the LAW and HLW PSARs and the PT facility pits, tunnels, and basemat portion of the PSAR were evaluated early to mitigate schedule risk and to provide BNI with early authorization to complete those parts of the facilities. The reviews ensured that the proposed partial and early construction activities would provide for adequate safety of the workers and the public by (1) applying the integrated safety management (ISM) process, which includes following the contractually prescribed process for requirements' and standards' identification and selection; (2) complying with applicable laws and regulations; and (3) conforming to DOE-stipulated top-level safety standards and principles. In addition, the review confirmed that the criteria of DOE O 420.1A, applicable to the LAW, HLW, and PT facilities, had been applied as required by 10 CFR 830.206(b).

2.1 Review Approach

The reviewers evaluated the submittal against the approval criteria listed in all relevant portions of RL/REG-99-05. For the ORP Manager to authorize construction of the LAW, HLW, and PT facilities, the reviewers determined whether the following criteria were met:[37]

- The proposed important-to-safety (ITS)[38] features were being implemented according to the approved Safety Requirements Document (SRD).
- Proposed changes to the SRD and the ISMP were acceptable.
- The design complied with the design-related sections of the updated SRD.

[37] DOE/RL-96-0003, *DOE Process for Radiological, Nuclear, and Process Safety Authorization, Verification, and Confirmation of the RPP Waste Treatment Plant Contractor*, Section 3.3.3, "Authorization for Construction."

[38] Important-to-safety refers to structures, systems, and components (SSCs) that reasonably ensure that the facility can be operated without undue risk to the health and safety of the workers and the public. It encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (i.e., normal operation as well as accident mitigation). This definition includes not only SSCs that perform safety functions and traditionally have been classified as safety class, safety-related or safety grade, but also those that place frequent demands on or adversely affect the performance of safety functions if they fail or malfunction, i.e., support systems, subsystems, or components. Thus, these latter SSCs would be subject to applicable top-level radiological, nuclear, and process safety standards and principles to a degree commensurate with their contribution to risk. In applying this definition, it is recognized that during the early stages of the design effort all significant systems interactions may not be identified and only the traditional interpretation of ITS, i.e., safety-related may be practical. However, as the design matures and results from risk assessments identify vulnerabilities resulting from non-safety-related equipment, additional SSCs should be considered for inclusion within this definition.

- The design properly accounted for the natural and manmade external events associated with the designated site.
- BNI was qualified by reason of experience and training to perform the proposed construction.
- The construction procedures were adequate to ensure that the construction-related part of the SRD would be properly implemented.
- The quality assurance (QA) plan was adequate and had been implemented such that the intended quality would be ensured in the ITS portions of construction and that the QA records would attest to that assurance.
- BNI had committed to comply with the conditions of the Authorization Agreement associated with the construction activities.

For the detailed review, the following activities were performed:

- Completed the review according to relevant portions of the guidance document (RL/REG-99-05)
- Prepared and maintained a public record file that contained the information that formed the basis for the review findings and included correspondence pertinent to the basis for the review findings
- Requested additional information from BNI through formally submitted questions to clarify the submittal[39]
- Prepared a draft SER
- Issued the final SER.

Table 2 lists the relevant sections of the review guidance (RL/REG-99-05) that were used to review each section of the LAW, HLW, PT, and BOF submittals.

2.2 Team Composition and Expertise

Internal and external experts were used to review the safety documentation submitted by BNI. Appendix A lists the reviewers who were involved in reviewing the LAW, HLW, and PT submittals.

[39] All the letters with OSR questions and BNI responses to the questions are listed in Section 8.0 of this SER.

Table 2. Review Criteria used for LAW, HLW, PT, and BOF PSAR Reviews

Volume I: General Information	**Review Guidance Section (RL/REG-99-05)**
1. Site Characteristics	1.1 Site Description
2. Facility Description	1.2 Facility Description 1.3 Process Description
3. Hazard and Accident Analysis	4.0 Preliminary Safety Analysis
4. Important-to-Safety Systems, Structures, and Components	4.5.3.3.3 Regulatory Acceptance Criteria
5. Derivation of TSRs	4.8 Technical Safety Requirements (TSRs)
6. Criticality Safety Program	6.0 Nuclear Criticality Safety
7. Radiation Protection	5.0 Radiological Controls
8. Hazardous Material Protection	DOE-STD-3009, Section 8, "Hazardous Material Protection"
9. Waste Management	10.3.3.1 Environmental Protection
10. Initial Testing, In-Service Surveillance, and Maintenance	3.10 Testing Program
11. Operational Safety	3.11 Operational Practices
12. Procedures and Training	3.4 Training and Qualification 3.9 Procedures
13. Human Factors	3.5 Human Factors
14. Quality Assurance	3.3 Quality Assurance
15. Emergency Preparedness	9.0 Emergency Management I. Draft Emergency Response Plan
16. Provisions for Deactivation and Decommissioning	11.0 Deactivation and Decommissioning
17. Management, Organization, and Institutional Safety	2.0 Organization and Administration 3.1 Configuration Management 3.6 Audits and Assessments 3.7 Incident Investigations 3.8 Records Management
18. Fire Protection	8.0 Fire Safety
Volume II: PT Facility Specific Information	**Review Guidance Section (RL/REG-99-05)**
1. Facility Description	1.2 Facility Description 1.3 Process Description
2. Hazard and Accident Analysis	4.0 Preliminary Safety Analysis
3. Important-to-Safety Systems, Structures, and Components	4.5.3.3.3 Regulatory Acceptance Criteria
4. PT Facility TSRs	4.8 Technical Safety Requirements (TSRs)
Volume III: LAW Facility Specific Information	**Review Guidance Section (RL/REG-99-05)**
1. Facility Description	1.2 Facility Description 1.3 Process Description
2. Hazard and Accident Analysis	4.0 Preliminary Safety Analysis
3. Important-to-Safety Systems, Structures, and Components	4.5.3.3.3 Regulatory Acceptance Criteria
4. LAW Facility TSRs	4.8 Technical Safety Requirements (TSRs)
Volume IV: HLW Facility Specific Information	**Review Guidance Section (RL/REG-99-05)**
1. Facility Description	1.2 Facility Description 1.3 Process Description
2. Hazard and Accident Analysis	4.0 Preliminary Safety Analysis
3. Important-to-Safety Systems, Structures, and Components	4.5.3.3.3 Regulatory Acceptance Criteria
4. HLW Facility TSRs	4.8 Technical Safety Requirements (TSRs)
Volume V: Balance of Facility	**Review Guidance Section (RL/REG-99-05)**
1. Facility Description	1.2 Facility Description 1.3 Process Description
2. Hazard and Accident Analysis	4.0 Preliminary Safety Analysis
3. Important-to-Safety Systems, Structures, and Components	4.5.3.3.3 Regulatory Acceptance Criteria
4. BOF Facility TSRs	4.8 Technical Safety Requirements (TSRs)

3.0 EVALUATION – GENERAL INFORMATION

This section describes the review that was performed on Volume I of the PSAR. The PSAR's format was based on DOE/STD-3009-94, Change Notice 1, dated January 2000. The general information volume of the PSAR contains 18 sections, 9 of which BNI addressed in the LAW PCAR submittal.[40] Volume I was subsequently modified to include 8 additional sections and a modification of the facility description section. No information was included initially in Volume I of the PCAR or PSAR on the criticality safety program. BNI subsequently submitted Chapter 6 on criticality safety on May 1, 2002, with the PT CAR. The evaluation of all sections as they are relevant to authorization to construct the LAW, HLW, BOF, and PT facilities is summarized below. The conditions of acceptance for the general information evaluation are contained in the conclusions portion of each section of this evaluation and in Appendix B.

3.1 Site Characteristics

The purpose of this review was to determine whether the PSAR adequately described the geographical, demographical, meteorological, hydrological, geological, and seismicity characteristics of the site and surrounding area. The site description must also be consistent with the site information presented in the most recent environmental impact statement (EIS)[41] and the relevant supplemental analyses for the RPP.

3.1.1 Requirements

The site description submittal was acceptable if it was presented at a level of detail appropriate to support the preliminary safety analysis (for the complete WTP) and if the criteria outlined below were met to support complete hazard analyses:

The site geography was described, including the location relative to prominent natural and manmade features such as mountains, rivers, airports, population centers, schools, and commercial and manufacturing facilities.

1. Population information was provided based on the most currently available census data to show distances to nearby population centers.

2. Appropriate meteorological data were included, such as design basis values for accident analysis of maximum snow or ice load; probable maximum precipitation; and the type, frequency, and magnitude of severe weather.

3. The area's hydrology was described, including the characteristics of nearby bodies of water, groundwater flow, and the design basis flood and precipitation events. The flood was at least a 100-year flood for the site and was consistent with U.S. Army Corps of Engineers' flood plain maps.

[40] 24590-WTP-PSAR-ESH-01-001-01.
[41] *Tank Waste Remediation System, Hanford Site, Richland, Washington Environmental Impact Statement*.

4. The geology of the area was described, including the soil characteristics of the site and any geological hazards.

5. The seismicity of the area and the hazard curves derived from them were described, including the characteristics of all seismic sources in the region of the site, such as magnitudes and frequency of recurrence of earthquakes, the travel path between the source and the site, and the attenuation effect of the geological materials in the travel path. All of the information provided was used to generate the site-specific seismic hazard curve and the response spectra.

6. Information was provided on the natural phenomena and manmade external events and the rationale for their selection, and nearby facilities and transportation were described. The discussion included which events were considered incredible and the justification for that determination.

7. The descriptions agreed with the site information contained in the most recent EIS and any relevant supplemental analyses for the RPP and with BNI's draft Emergency Response Plan.

3.1.2 Evaluation

The reviewers found the description of site characteristics in Volume I of the LAW PSAR to be conditionally acceptable. Seven of the eight acceptance criteria listed above were found acceptable and one was conditionally acceptable. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the description of site geography to be acceptable. The site location relative to prominent natural and manmade features such as mountains, rivers, airports, population centers, schools, and commercial and manufacturing facilities was clearly identified.

2. The reviewers found the population information near the site location to be acceptable. The population information was based on the most currently available census data.

3. The reviewers found the descriptions of meteorology, hydrology, and geology of the facility site and surroundings area to be acceptable. The reviewers also found the information on the design basis for wind, snow, and flood to be acceptable. The PSAR also included the following site information: maximum peak gusts, annual probability of wind distribution, monthly averaged and extreme precipitation amounts, annual probability of precipitation distribution, and maximum and averaged monthly and annual snow fall. The reviewers found the information on severe weather, which includes dust, thunderstorms, lightning strikes, and range fires, to be acceptable.

4. The reviewers found the description of hydrology for the site and surrounding areas to be acceptable. The evaluation included the characteristics of nearby bodies of water and groundwater flows and the possibility of a flood accident because of failure of the Grand

Coulee Dam. The U.S. Army Corps of Engineers evaluated the site's flood scenario and concluded that such a flood would not directly affect the site.

5. The reviewers found the description of the site's geology and the surrounding areas to be acceptable. The evaluation included the soil structure and seismicity of the site and the surrounding areas.

6. The reviewers found the description of the site's soil structure and seismicity to be acceptable. The evaluation included characteristics of all seismic sources in the site and the surrounding areas, such as magnitudes and frequency of recurrence of earthquakes, the travel path between the source and the site, and the attenuation effect of the geological materials in the travel path. The peak ground acceleration, seismic hazard curves, and seismic design response spectra of the site based on the site-specific seismicity were developed.

7. The reviewers found the description of natural phenomena and manmade external events, nearby facilities, and transportation to be conditionally acceptable. Natural phenomena such as seismic events, wind, snow, and flood were described. The manmade external events that were evaluated included aircraft activity and other transportation accidents near the site. The PSAR also described nearby facilities and their possible effects on the site. Reviewers found the assessment of hazardous material releases including transportation events and associated impacts on habitability of WTP control rooms incomplete and the assessment of impacts from ashfall events on ITS SSCs incomplete. Evaluation of these events is documented in Section 4.1.1.2 and 4.2.1.2 of this SER for hazardous material release events including transportation and Section 4.3.3.2, Item 5 of this SER for ashfall events.

8. The reviewers found acceptable the PSAR's statement that it was consistent with the site EIS and its draft Emergency Response Plan as to the information on site characteristics.

3.1.3 Conclusions

The reviewers concluded that PSAR Volume I met the requirements of the site characteristics description for the PSAR. The PSAR adequately provided all required information on site characteristics necessary for the hazard and accident evaluations.

3.2 Facility Description

The purpose of this review was to determine whether the PSAR adequately described the facility features pertaining to construction of the WTP ITS facilities[42] that could affect any potential accidents (at the completed facility) and their consequences. Examples of these features are facility location, facility design information, and the location and arrangement of buildings on

[42] As used in this SER, WTP ITS facilities refer to the LAW, HLW, and PT full facilities and selected portions of the BOF structures and systems.

the facility site as well as the general arrangement, function, and operation of the major components in the process. This review was specific to Volume I, *General Information*, of the PSAR as it related to facility description.

3.2.1 Requirements

DOE/RL-96-0003, Section 4.3, "Authorization for Construction," contains the fundamental requirements for facility features, requiring the Contractor to describe the facility SSCs, including those designated as ITS. BNI's SRD contains additional applicable requirements. SRD Safety Criterion 4.1-2 addresses SSCs designated as ITS and provides requirements that they be designed, fabricated, erected, constructed, tested, inspected, and maintained to quality standards commensurate with the ITS functions to be performed. Safety Criterion 4.1-3 addresses natural phenomena hazards (NPHs) design for SSCs that are ITS and have NPH safety functions, such as the ability to withstand the effects of earthquakes, wind, floods, missiles, volcanic ash, and snow loading. Safety Criterion 4.1-4 addresses NPH design for SSCs that are ITS without NPH safety functions.

The facility description was acceptable if it was presented at a level of detail appropriate to support the portions of the PSAR relevant to construction of the WTP ITS facilities, if description identified and described the features that were ITS, and if the criteria outlined below were met to support complete hazard analyses:

1. The facility location and the distance from the site boundary in all directions, including the distance to the nearest resident, were provided.

2. The layout and location of buildings on the facility site were provided, using scaled drawings to show the plant layout, including plant structural features such as buildings, towers, tanks, and transportation right-of-ways. The relationship of specific facility features to the major processes that will be ongoing at the facility was described.

3. Design information was provided on the facility's ability to resist failures of ITS SSCs when those failures are caused by credible external and internal events and could produce consequences of concern. Also, information pertaining to the applicable design loads and various loading combinations was provided.

4. Information was provided on the imposed design limits that serve to quantify the structural behavior of the concrete and steel structures, specifically the required strength for various loading combinations.

5. Information was provided on the design and analysis processes used for the ITS structures.

6. Information was provided on ITS electrical systems and components.

7. Information was provided on ventilation and air cleaning systems and components.

8. Information was provided on protecting control room atmospheres.

9. Information was provided on effluent stacks.

3.2.2 Evaluation

The reviewers found that the facility description acceptably met all nine of the review criteria. Information on facility location and design was provided in Chapters 1 and 2 of Volume I of the PSAR, calculation reports, other documents referenced in the PSAR, and responses to reviewer questions related to the design and analysis of the LAW, HLW, and PT facilities. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the information on the facility location and distances between the LAW, HLW, and PT facilities and other adjacent buildings to be acceptable. The information on soil properties, NPHs (e.g., seismic, wind, flood, snow, and ashfall), and aircraft activity was acceptable for LAW, HLW, and PT facilities design load definition. In the LAW, HLW and PT PSAR submittals, the site location was clearly identified to the extent needed for the PSAR. The Contract statement of work required the WTP facility to be located on this site. The reviewers considered the information provided to be acceptable for subsequent calculations of potential impacts to the environment and to the public from eventual operation of the LAW, HLW, PT, and BOF facilities.

2. The reviewers found acceptable the information on facility layout, as described in Section 2.3.3, outlining the major processes in the LAW, HLW, and PT facilities and at a detail appropriate to support the location of the LAW, HLW, PT, and BOF facilities. The relationship of the LAW, HLW, and PT facilities and features to the major processes that will be ongoing at the facility was provided in Volume II of the PT PSAR, Volume III of the LAW PSAR, and Volume IV of the HLW PSAR and was not evaluated here as part of the general information review.

3. The reviewers found acceptable the information, as described in Section 2.4, on the ability of the WTP ITS facilities to resist failures of their ITS functions due to credible internal and external events. The reviewers' specific assessments were as follows:

   (a) The reviewers found the general information on required codes and standards to be acceptable because it met the requirements of SRD Safety Criteria 4.1-3 and 4.1-4.

   (b) The reviewers found acceptable the general information on (1) loads encountered by the WTP ITS facilities during normal plant operation, including dead loads, live loads, thermal loads, snow loads, ashfall loads, lateral earth pressure loads, wind loads, and flood loads, and (2) loads sustained during severe and extreme environmental conditions, including earthquake loads, accident thermal loads, and other postulated loads from drops. This information was adequate to develop the design basis parameters necessary for the structural design. Additional facility-specific load definitions and information are provided in Volume II of the PT

PSAR, Volume III of the LAW PSAR, Volume IV of the HLW PSAR, and Volume V of the BOF PSAR and are discussed in Sections 4.3.1.2, 4.1.1.2, 4.2.1.2, and 4.4.1.2 respectively, of this SER.

(c) The reviewers found the information on various load combinations and load factors for the reinforced concrete in the WTP ITS facilities to be acceptable because they were consistent with the requirements of the SRD Safety Criteria 4.1-3 and 4.1-4 codes and standards. Additional information was provided in Volume II of the PT PSAR, Volume III of the LAW PSAR, Volume IV of the HLW PSAR, and Volume V of the BOF PSAR and is discussed in Sections 4.3.1.2, 4.1.1.2, 4.2.1.2, and 4.4.1.2, respectively, of this SER.

4. The reviewers found acceptable the general information on the imposed design limits related to reinforced concrete in the WTP ITS facilities, described in Volume I of the LAW PSAR, because they were consistent with the requirements of SRD Safety Criteria 4.1-3 and 4.1-4. Additional information was provided in Volume II of the PT PSAR, Volume III of the LAW PSAR, Volume IV of the HLW PSAR, and Volume V of the BOF PSAR and is discussed in Sections 4.3.1.2, 4.1.1.2, and 4.2.1.2, respectively, of this SER.

5. The reviewers found the general description on the design and analysis processes to be used for the WTP ITS facilities acceptable because it was consistent with SRD Safety Criteria 4.1-3 and 4.1-4 requirements. Specific information on structural boundary conditions and additional design and analysis processes as provided in Volume II of the PT PSAR, Volume III of the LAW PSAR, Volume IV of the HLW PSAR, and Volume V of the BOF PSAR and is discussed separately in Sections 4.3.1.2, 4.1.1.2, 4.2.1.2, and 4.4.1.2, respectively, of this SER.

6. Information on design of the electrical systems and components, such as power supplies to buildings, was provided in Volume I of the PSAR. Full review of information on design of electrical systems was done as part of the facility-specific PSAR reviews.

7. Information on ventilation and air cleaning systems and components was provided in Volume I of the PSAR. Full review of the ventilation and air cleaning system designs was done as part of the facility-specific PSAR reviews.

8. Information on protecting control room atmospheres was provided but not reviewed. Full review of information on protecting control room atmosphere was done as part of the facility-specific PSAR reviews.

9. In Volume I of the PSAR, only general information on the location of the effluent stacks was provided because BNI did not consider the stack to be important to the structural design of the LAW, HLW, and PT facilities and basemat and therefore not relevant to the stack's ability to withstand NPH events and off-normal conditions that may arise during plant operation. The reviewers found this acceptable. Additional information was provided in Volume II of the PT PSAR, Volume III of the LAW PSAR, and Volume IV

of the HLW PSAR and is discussed in Sections 4.3.1.2, 4.1.1.2, and 4.2.1.2, respectively, of this SER.

3.2.3 Conclusions

The reviewers concluded that the information in Volume I of the PSAR met the requirements of the facility description for the PSAR. The PSAR adequately described the general facility description that could affect potential accidents at the completed facilities and that may have an impact on the structural design of the LAW, HLW, BOF, and PT facilities.

3.3 Hazard and Accident Analysis

The purpose of this review was to determine whether the PSAR adequately described the process to be used to conduct the hazard and accident analysis and whether the process complied with the SRD and ISMP. The review was to evaluate the process for identifying and selecting internal and external design basis events (DBEs) as part of the accident analysis. The review was also to provide confidence that the methods used for the hazard and accident analysis, if properly applied, will result in facility design, construction, operation, maintenance, and deactivation in a manner that protects the health and safety of the workers, the public, and the environment. The review was specific to the submittal as it related to the process used for hazard and accident analysis described in PSAR, Volume I, *General Information*.

3.3.1 Requirements

The description of the hazard and accident analysis process was acceptable if it was presented at a level of detail appropriate to support the PSAR. As identified in the SRD, Appendix A, Section 4.0, "Hazard Evaluation," the hazard and accident analysis process was acceptable if it addressed the nine criteria for hazard and accident analysis:

1. **Identifying Hazards** – Hazards associated with the facility processes, design, and operations were systematically identified.

2. **Identifying Potential Accident/Event Sequences** – Potential accidents were examined in a structured, systematic approach.

3. **Estimating Accident Consequences** – The consequences for postulated accidents were examined.

4. **Estimating Accident Frequencies** – Internal and external accident frequencies were estimated.

5. **Considering Common-Cause and Common-Mode Failures** – Credible common-cause events were considered, such as natural phenomena events, external manmade events, loss of electrical power, fire, internal missiles, and internal flooding.

6. **Defining DBEs** – A set of internal and external DBEs was identified that defined a set of bounding performance requirements for the SSCs relied on to control the hazards. For internal DBEs, the PSAR was acceptable if it described the method used to identify and analyze internal DBEs and the process for assessing associated risks.[43] The PSAR also described the process for binning internal DBE accidents according to the initiating events, accident phenomena, and identified control strategy. The PSAR was acceptable if a process to select internal DBEs was identified that represented the highest consequence and if both the unmitigated consequences (as part of hazards identification) and mitigated consequences (as part of the accident analysis) for the identified DBEs were calculated.

   For external DBEs, the PSAR was acceptable if the process for selecting both the facilities' seismic events and the seismic design criteria was identified, including development of the seismic hazard curves and response data.[44] The seismic acceptance criteria described the process to compare the calculated seismic demand on ITS SSCs from the seismic analysis with the corresponding seismic capacity derived from the acceptance criteria of SRD-required implementing codes and standards.

   The PSAR was acceptable for other external DBEs if it described methods for assessing DBEs from wind, missiles propelled by wind, flooding, loads due to volcanic ash, loads due to snow, and man-made external accident events such as aircraft crashes.

7. **Defining the Operating Environment** – A set of bounding operating conditions in which ITS SSCs must function was identified. The operating environment included temperature, pressure, humidity, radiation levels, and chemical environment.

8. **Identifying Potential Control Strategies** – Potential hazard control strategies were identified to manage each potential accident.

9. **Documenting the Hazard Evaluation** – The hazard evaluation was documented in a Hazard Analysis Report.

In addition to the nine criteria for hazard and accident evaluation, the PSAR was acceptable if it provided methods for identifying assumptions, including those affecting the estimation of the frequency or consequences for each potential accident, and methods for analyzing uncertainty. Significant uncertainties should be identified for evaluation during the facility-specific hazard and accident analysis.

The process for evaluating the chemical process safety of the design was acceptable if it was adequate to identify the chemical hazards and integrate the chemical accident analyses into the overall preliminary safety analysis.[45] The PSAR was acceptable if BNI had implemented or committed to implement the 12 elements of a process safety management program as outlined in its SRD and ISMP;[46] if appropriate techniques, such as those described in the American Institute

[43] RL/REG-99-05, Section 4.5, "Internal DBEs."
[44] RL/REG-99-05, Section 4.6, "External DBEs."
[45] RL/REG-99-05, Section 7.3, "Acceptance Criteria."
[46] RL/REG-99-05, Section 7.2, "Areas of Review."

of Chemical Engineers' (AIChE's) *Guidelines for Hazard Evaluation Procedures, Second Edition with Work Examples*, were used for hazard evaluation and quantitative risk assessment; and if valid assumptions were used to assess the chemical process hazards.

3.3.2 Evaluation

The reviewers found all nine review criteria were met in the PSAR's description of the hazard and accident analysis methods and process to be applied. The evaluation of the information for each review criterion is summarized below:

1. **Identifying Hazards** – The reviewers found the description of the process for identifying hazards for the facility processes, design, and operations to be acceptable, as described in Sections 3.3.1, 3.3.2, 3.3.2.1, and 3.3.2.2 of the PSAR. The technique chosen was based on AIChE's recommendations in its *Guidelines for Hazard Evaluation Procedures*, which was consistent with the SRD, Appendix A, Section 4.1, "Identification of Hazards." This approach was also consistent with the other requirements associated with identifying the hazards, including SRD Safety Criteria 3.1-1 and 3.2-1 and the SRD, Appendix A, Section 4.2, "Identification of Potential Accident/Event Sequences." The AIChE methods include a complete analysis of all potential initiating events, including human error, with the preferred approach being a hazard and operability analysis technique. The PSAR stated that knowledgeable individuals from varying disciplines conducted the analysis, as required for the specific review in question.

   The PSAR committed to address the characteristics of chemicals and potential process byproducts, including using a chemical interaction matrix for each facility and developing documentation (i.e., a hazard map). The methodology described the commitment to provide facility-specific information on the chemical inventories, equipment capacities, energy sources, and other environmental conditions so that all hazards were identified. The PSAR methodology does not require consideration of accidents resulting from holding chemicals for long periods because this was assumed to be prevented by normal operating procedures. The reviewers agreed that this approach was acceptable and consistent with industry practice for process chemicals.

   The reviewers noted that the hazards evaluation approach considered radionuclide concentrations and material inventories in LAW – derived from feeds to PT – with inventories at the Contract maximum values, except for additional restrictions placed on ^{125}Sb and ^{241}Am. PSAR Volume I did not justify the rationale for restricting the concentrations of these two radionuclides. In response to Question LAW-PCAR-014 concerning radionuclide concentrations, BNI referenced calculations that assumed the LAW radionuclide concentrations and material inventories (source term) should be based on the LAW PT processes and controls. The reviewers found this response acceptable.

   The reviewers also noted that the analyses considered doses to workers. The accident analysis methods, models, and parameters for offsite individuals were typically based on substantial experience where accepted protocols and methods had been established. However, the reviewers were not aware of any consensus methods or protocols that had

been established for estimating worker doses during accidents. Further, because of worker proximity to the accident and the variability of potential conditions, doses to facility workers from accidents can be difficult to quantify and will rely on engineering judgment.

ORP evaluated this situation in a position paper on calculating facility worker doses.[47] The reviewers determined that the methods described in the PSAR were consistent with ORP's position. Therefore, the worker accident dose methods were acceptable.

2. **Identifying Potential Accident/Event Sequences** – The reviewers found the definition of the methodology for identifying potential accident/event sequences to be acceptable, as discussed in Sections 3.3.2.1, 3.3.2.2, 3.3.5, 3.4.4, and 3.8 of the PSAR. The method involved applying the ISM process to each WTP facility and design area, with different ISM teams assigned to each area, depending on the complexity and number of identified systems. This approach was consistent with SRD Safety Criterion 3.2-1 and the implementing codes and standards found in the SRD, Appendix A, Section 4.2, "Implementing Standard for Safety Standards and Requirements Identification."

The ISM team was comprised of knowledgeable and qualified staff. In response to Question LAW-PCAR-011 concerning selection of the preliminary safety analysis team, BNI stated that potential team members were screened, beginning with basic resume reviews and interviews, and then trained. The ISM team was required to document the hazard, the initiating event, and the hazardous situation. The team could use various hazards identification techniques, ranging from applying engineering judgment to numerical methods, depending on the hazards involved with a particular system. In this manner, the ISM team would characterize the accident sequence for further review. The ISM team then recorded information on the unmitigated consequences and assumptions regarding accident/event frequencies in Standards Identification Process Database (SIPD)[48] records. Accident severity levels, as defined in the SRD, Appendixes A and B,[49] were then assigned based on the unmitigated consequence estimates.

The reviewers found the methodology required that common-cause accidents be evaluated as part of the overall WTP operations risk assessment, designed to confirm that the facility will meet the prescribed radiological exposure standards in SRD Safety Criterion 2.0-1, the chemical risk exposure standards in SRD Safety Criterion 2.0-2, and the associated risk goals.

The methodology for selecting potential accident sequences appropriately linked initiating events with prevention and mitigation control strategies through the ISM review process. The identified accidents were grouped by similar control strategies, release

[47] ORP/OSR-2001-17, *The Office of Safety Regulation Position on the Calculation of Facility Worker Doses from Seismic and Non-Seismic Events*.
[48] BNI maintains the SIPD as a repository for the results of the hazard analysis and control strategy selection processes.
[49] Appendix A, "Implementing Standard for Safety Standards and Requirements Identification," and Appendix B, "Implementing Standards for Defense in Depth."

mechanisms, and consequences to develop a representative set of DBEs, which were the bounding events for each group of accidents identified. Where data were lacking or incomplete, the methodology included appropriate conservatism. The reviewers determined that this approach to selecting DBEs and applying the identified ISM methods was both comprehensive and credible. The overall methodology considered secondary events caused by external conditions, such as accidents at nearby facilities and aircraft crashes. The reviewers determined that the criterion for determining when selected events were incredible and not subject to further analysis was that the initiating event frequency must be estimated to be much less than 10^{-6}/yr, which is conservative.

3. **Estimating Accident Consequences** – The reviewers found the methods for estimating accident consequences to be acceptable, as provided in Sections 3.3.2.3, 3.3.2.4, 3.4.2, and 3.4.3 of the PSAR. The methods relied on estimating radiation doses using bounding unmitigated evaluations, which were recorded in control strategy development (CSD) records. The methods were consistent with SRD Safety Criteria 3.1-3 and 3.1-4 and the SRD, Appendix A, Section 4.3, "Estimation of Consequences." The methods for conducting quantitative dose evaluations to determine severity levels were found in 24590-WTP-GPG-SANA-004, *Design Guide: Radiological Consequence Analysis*.

   The reviewers determined that the PSAR adequately described the basis for estimating unmitigated accident consequences that did not credit active or passive SSCs or administrative controls that could reduce the consequences of the accident. The design guide provided a complete description of the methods used to develop source terms and to evaluate downwind transport and consequences using appropriate methods and dose conversion factors to determine total effective dose equivalents. The methods applied the same five-factor formula found in Volume 2 of NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*, and in DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. The methods included consideration of external radiation fields and exposure durations for each of the exposed populations. The reviewers determined that the PSAR provided an appropriate method for evaluating the potential consequences of releases of hazardous chemicals, using Emergency Response Planning Guidelines (ERPG) or equivalent limits, consistent with the requirements of SRD Safety Criterion 2.0-2. As described in Item 2 above, the reviewers found that the criteria for binning accidents were acceptable.

4. **Estimating Accident Frequencies** – The reviewers found the definition of the process for estimating accident frequencies to be acceptable, as discussed in PSAR Sections 3.3.2.4, 3.4.5, and 3.8. In response to Question LAW-PCAR-016 concerning the technical basis used to estimate accident frequencies, BNI stated that the approach was defined in 24590-WTP-GPG-SANA-002, *Design Guide: Integrated Safety Management*, and was consistent with the requirements found in the SRD, Appendix A, Section 4.4, "Estimation of Accident Frequencies." The methods considered both the frequency of the initiating event and the estimated frequency of failure (i.e., the reliability) of preventive and mitigative control strategies. The design guide provided an acceptable method for estimating frequencies considering engineering judgment, more quantitative methods, and the addition of margins to account for uncertainties induced by more qualitative methods.

5. **Considering Common-Cause and Common-Mode Failures** – The reviewers found acceptable the methodology for analyzing and discussing common-cause and common-mode failures, as found in Sections 3.3.5 and 3.4.1 of the PSAR. These sections were consistent with the SRD, Appendix A, Section 4.5, "Consideration of Common Cause/Common Mode Failures." The methods considered NPH events, external man-made events, loss of electrical power, fire, internal missiles from pressurized components and rotating equipment, and human error. The NPH events included earthquake, straight winds, missile propelled by wind, volcanic ash, storm-induced flooding, snow loading, and range fires.

   The analysis focused on identifying provisions to prevent the loss of safety functions resulting from credible common-cause failures, as discussed in 24590-WTP-GPG-SANA-002. The methodology required documenting assumptions that may affect the frequency or consequences for each potential accident, including those involving common-cause and common-mode failures. These assumptions were tracked and evaluated to determine if they induced uncertainties in either the estimated consequences or frequencies and if they influenced the design, work descriptions, or operational conditions. In response to Question LAW-PCAR-019 concerning accident dependencies, BNI stated that the process for evaluating severity levels for catastrophic failures during earthquakes for the LAW facility, including consideration of common-cause failures, was documented in 24590-LAW-Z0C-S30T-00001, *Seismic Categorization of the LAW Facility*. A similar calculation was done for the HLW facility in 24590-HLW-Z0C-S30T-00001, *Design Basis Event: HLW Facility Seismic*. The reviewers determined that the hazard and accident analysis was conducted in a manner that accounted for uncertainties by providing conservative estimates of the initiating event and by considering SSCs in the ISM process that prevent or mitigate a hazardous situation. This approach provided a conservative method for meeting the exposure standards and considered frequency and uncertainty.

6. **Defining DBEs** – The reviewers found acceptable the accident analysis process for defining DBEs, as described in Sections 1.5, 2.4, and 3.3.7 of the PSAR. The process described for identifying facility-specific DBEs was consistent with SRD Safety Criteria 3.4-1 (Item 4), 4.1-3, 4.1-4, 4.1-5, 4.2-1, 4.2-2, and 4.2-3 [as implemented through the ISMP, Sections 1.3.4 and 5.5 (both entitled "Process Hazards Analysis")] for internal and external initiating events. The reviewers also found that the PSAR was consistent with the SRD, Appendix A, Section 4.6, "Definition of Design Basis Events," and with the selected standards.[50] However, a few deviations from the standards were noted. Instead of assigning a risk ranking matrix (similar to that described in AIChE's guidelines) to bin accidents for determining DBEs, a combination of control strategy, consequence, and accident type was used. Although a deviation, the general types of accidents identified were comprehensive and complete, and the reviewers found the approach to be acceptable. The details for conducting the hazard and accident analysis supporting the identification of DBEs was found in BNI's design guide, 24590-WTP-GPG-SANA-004. As described in Item 3 above, the design guide contained the five-factor formula and

[50] AIChE, *Guidelines for Hazard Evaluation Procedures, Second Edition with Work Examples*.

appropriate references to supporting documentation. For the seismic analysis, a probabilistic risk analysis using documented methods[51] will be conducted.

7. **Defining the Operating Environment** – The reviewers found acceptable the methods for defining and tracking the operating environment through the design process, as described primarily in Section 3.3.4 of the PSAR. This section was consistent with Item 4 of SRD Safety Criterion 3.1-4, which requires that the hazard analysis consider normal operational and accidental conditions. The PSAR also was consistent with the SRD, Appendix A, Section 4.7, "Definition of Operating Environment," which required that the hazard evaluation define a set of bounding operating conditions within which SSCs relied on to control hazards must function. These conditions included temperature, pressure, humidity, radiation levels, and the chemical environment. The process relied on this information being identified as part of the ISM accident identification process. The environmental conditions to which ITS equipment may be subjected during each specific accident is established and entered into SIPD for tracking. Operating environmental parameters are specified on a case-by-case basis considering the characteristics of each identified accident.

8. **Identifying Potential Control Strategies** – The reviewers found the process for identifying potential control strategies, as primarily described in Section 3.3.3 in the PSAR, to be acceptable. The method relied on the ISM process to evaluate the hazards and proposed control strategies relevant to the facility design, using ISM review teams. The process required the teams to ensure that the relevant SRD safety criteria and implementing codes and standards are included in identifying control strategies. Because DBEs were determined in part based on similarity of control strategies, identifying potential control strategies was an integral part of the hazard analysis approach.

9. **Documenting the Hazard Evaluation** – The reviewers found the commitment to document the results of the hazard evaluation, as discussed in PSAR Section 3.3.7, to be acceptable. The process required the PSAR to document the accident sequences, linking initiating events with preventive and mitigative measures relevant to the accident sequence progression, the rationale for sorting accidents for further evaluation, the description and binning of credible accident sequences, and an evaluation of external events.

   In response to Question LAW-PCAR-020 concerning binning of potential accidents, BNI stated that the procedures for identifying hazards and appropriate control strategies were found in 24590-WTP-GPP-SANA-002C, *Hazards Analysis Development of Hazard Control Strategies and Identification of Standards*, and 24590-WTP-GPG-SANA-002. As discussed in Item 3 above, the documentation in subsequent PSAR volumes will consider both radiation doses and exposures to hazardous chemicals and will document the results of the DBE selection process. The reviewers verified that common-cause and common-mode events, including those resulting from natural phenomena, were included in documenting the analysis of each facility in subsequent PSAR volumes. The reviewers

[51] RPT-W375-NS00005, *Seismic Probabilistic Risk Analysis Methods.*

> determined that the analysis methods accounted for human error during maintenance activities. The reviewers noted that in the response to Question LAW-PCAR-020, BNI committed to address conservatism in the modeling and data and the role of conservatism in offsetting uncertainty, consistent with past safety analyses.[52]

The reviewers evaluated the process used to evaluate the chemical process safety of the design. The reviewers found the discussion of the 12 elements of a process safety management program, as required in the SRD and ISMP, to be acceptable. The description of the chemical process safety evaluation process was consistent with the preliminary level of design. Volume I of the PSAR described the methodology used to conduct the preliminary hazard analysis, while PSAR Volumes III and IV (Tables 3-2, 3-3, and 3-4) provided chemical properties, hazards, and interactions, respectively. Appendix A of Volumes III and IV included the accident sequences involving potential chemical hazards. PT PSAR Volume II (Tables 3A-4, 3A-5, and 3A-6) provided process chemicals, hazardous characteristics, and interactions, respectively.

3.3.3 Conclusions

The reviewers concluded that the description of the methodology for conducting the hazard and accident analysis, including the process to be used to identify and analyze internal and external DBEs, was acceptable. The review provided confidence that the methods used for the hazard and accident analysis, if properly applied, will result in facility design, construction, operation, maintenance, and deactivation in a manner that protects the health and safety of the workers, the public, and the environment.

The reviewers concluded that the chemical process safety submittal was acceptable. The PSAR adequately described the chemical process safety program, including the 12 elements of a process safety program.

3.4 Important-to-Safety SSCs

The purpose of this review was to determine whether the PSAR adequately described a process for identifying and documenting the ITS SSCs and the most severe anticipated conditions under which they must function. This review was specific to the PSAR, Volume I, *General Information*, as it related to the process to be used to identify facility-specific ITS SSCs.

3.4.1 Requirements

The submittal was acceptable if it described the process for identifying ITS SSCs and if the process considered the bounding operating conditions under which the SSCs relied on to control hazards must function. Environmental parameters to be addressed include temperature, pressure, humidity, radiation level, and chemical environment.[53] The operating environment during

[52] RL/REG-99-05, Section 4.4.3.3, "Regulatory Acceptance Criteria," Item 5, second paragraph.
[53] SRD, Appendix A, Section 4.7, "Definition of Operating Environment."

normal operations and under off-normal and accident conditions, as they would affect design related ITS SSCs, was considered in determining hazard control strategies.

The submittal was required to use a systematic process to identify the DBE characteristics, operating environment, and performance requirements; and the results were expected to be justified and documented for each ITS SSC. The documented process was expected to use the following outline, to be repeated for each ITS SSC in the facility-specific submittals:[54]

1. **SSC Identification** – This identified the ITS SSC.

2. **Safety Function** – This defined the reason for designating the SSC as ITS and specifically identified its preventive or mitigative safety function(s) as determined in the hazard and accident analysis. The specific accidents associated with the safety function also were identified.

3. **System Description** – This described the ITS SSC and its safety function(s), its boundaries, and its interface points with other SSCs relevant to the safety function. When the ITS SSCs were described, the physical information known about the SSC was summarized.

4. **Functional Requirements** – This identified requirements that are specifically needed to fulfill safety functions. The functional requirement designation was limited to requirements necessary for the safety function. Functional requirements specifically addressed the safety relevant response parameters or nonambient environmental stresses related to an accident that determined the need for the SSC's ITS designation.

5. **System Evaluation** – This provided performance criteria imposed on the ITS SSC to meet needed functional requirement(s) satisfying the identified safety function. In determining performance criteria for ITS SSC, existing criteria, such as single-failure criteria, were considered. The capabilities of the ITS SSC were evaluated and shown to meet the performance criteria. The evaluation was as simple as possible and relied on design, engineering judgment, calculations, or performance tests.

6. **Controls (technical safety requirements [TSRs]).** This identified assumptions associated with the ITS SSCs that require TSRs to ensure performance of the safety function.

3.4.2 Evaluation

The reviewers found the PSAR submittals on the process for identifying, evaluating, and documenting ITS SSCs to be acceptable. The evaluation of the information for each outline element is summarized below:

[54] RL/REG-99-05, Section 4.5.3.3.3, "Regulatory Acceptance Criteria."

1. **SSC Identification** – The reviewers found the information provided on SSC identification in PSAR Sections 4.3 and 4.4 to be acceptable. The ISM process required that each ITS SSC be specifically identified in the SIPD. ITS SSCs were designated safety design class (SDC) or safety design significant (SDS) using the approach described in the SRD, Appendix B, "Implementing Standards for Defense in Depth." The SSCs may be specified at the system level or at the major component level as specifically identified in the DBE analysis.

2. **Safety Function** – The reviewers found the documentation of the safety function of ITS SSCs to be acceptable. The ISM process, defined in BNI's K70DG528, *Design Guide - Integrated Safety Management*, required that the reason for designating an SSC as ITS, resulting from the hazard and accident analysis, be specifically identified and documented in the SIPD.

3. **System Description** – The reviewers found the description of the required information for SDC and SDS SSCs to be acceptable. PSAR Sections 4.3 and 4.4 committed to describe each ITS SSC and its safety function, supported by drawings and any other essential information.

4. **Functional Requirements** – The reviewers found the information on functional requirements to be acceptable. PSAR Sections 4.3 and 4.4 committed to identify the safety functional requirements of ITS SSCs. Functional requirements are specified for SSCs to address the environmental stresses that may be encountered. The accident scenarios are required to be identified using the most severe environmental conditions that could be encountered and the information recorded and maintained as part of SIPD. These conditions encompass the operating environment for both normal operations and off-normal conditions. For an active SSC, the credited safety function is required to be preserved by applying the defense-in-depth principle so that the safety function is accomplished in spite of the failure. The DBEs include NPHs such as earthquakes.

5. **System Evaluation** – The reviewers found the information on system evaluation to be acceptable. PSAR Sections 4.3 and 4.4 committed to provide performance criteria imposed on the ITS SSCs to meet the functional requirements and satisfy the safety functions. The system evaluation was required to be as simple as possible, relying on design, engineering judgment, calculations, or performance tests.

6. **Controls (TSRs)** – The reviewers found the approach to produce a set of draft TSRs, as described in PSAR Sections 4.3 and 4.4, when combined with the application of safety criteria, to be acceptable. The ISM process, as described in PSAR Section 3.3.3, included definition of assumptions for developing TSRs to ensure that the SSCs can perform their safety functions.

3.4.3 Conclusions

The reviewers concluded that the PSAR described the six outline elements that will be included for each ITS SSC in facility-specific volumes of the PSAR. The PSAR described and committed

to an acceptable method for identifying and documenting the methods to be used to identify ITS SSCs.

3.5 Derivation of TSRs

The purpose of this review was to determine whether the PSAR adequately described the process used to select TSRs for the hazard control provisions and strategies for the facility according to applicable requirements of the SRD. The review also was to determine whether the PSAR provided the basis for developing TSRs to ensure that the facility will operate within the analyzed safety basis. This review was specific to the PSAR, Volume I, *General Information*, as it related to the process used to select TSRs.

3.5.1 Requirements

Table S7-1 of the BNI Contract specifies the requirements for submitting draft TSRs and states that draft TSRs will be submitted with the CAR. The SRD defined the required content of the TSRs. SRD Safety Criterion 9.2-1 stated that TSRs shall be prepared and submitted for approval and the facility shall be operated according to the approved TSRs. SRD Safety Criterion 9.2-3 describes the standard for TSRs, consisting of safety limits (Item 1) and limited control settings (Item 2a), each of which was further defined in the SRD. Finally, SRD Safety Criterion 9.2-4 stated that TSRs shall be kept current at all times so they reflect the facility as it exists and as it is analyzed in the safety analysis report.

3.5.2 Evaluation

This part of the review was specific to PSAR Volume I, Section 5, which described the WTP plant-wide approach for deriving TSRs. The common approach was used to derive TSRs for the individual WTP nuclear facilities. Facility-specific TSRs were submitted with the LAW, HLW, and PT PSARs and are discussed in the facility-specific sections on this SER (see Sections 4.1.3, 4.2.3, and 4.3.3).

The derivation of TSRs was reviewed against the acceptance criteria in RL/REG-99-05, Section 4.8.1.3, and the requirements of SRD Safety Criterion 9.2-3 and found to be acceptable. The submittal appropriately selected potential TSRs that provided an adequate basis for developing operating limits to ensure that the facility would be operated within the analyzed safety basis. The information provided in the submittal was consistent with the current status of the facility and process design.

TSRs were based on and derived from the WTP safety functions and administrative controls described in PSAR Chapter 3 of the facility-specific volumes and on specific information on safety functions for SDC and SDS features described in the facility-specific PSAR Chapter 4. TSR derivation criteria were found to be acceptable because the criteria were based on the TSR development guidance in the WTP Project implementing standard (SRD, Section 9.2, "Technical

Safety Requirements") and SRD, Appendixes A, "Implementing Standard for Safety Standards and Requirements Identification," and C, "Implementing Standards."

Derived TSRs included requirements for operating limits, technical and administrative conditions, availability of safety equipment and systems, and safety functions of instrumentation and controls. Operating limits were based on values specified in the PSAR, codes, standards, guides, risk assessments, and manufacturer's documentation. The reviewers found this acceptable and in accordance with the requirements of SRD Safety Criterion 9.2-3.

The reviewers found the derivation considerations used to develop TSRs to be acceptable. The ISM process was used to perform TSR derivation screening. The TSRs ensure that the facility will be safely operated within limits to protect the health and safety of the public and facility workers as determined in the accident analysis. Safety limits, limiting conditions of operation, administrative controls, and design basis were derived. Administrative controls were derived as necessary to support operating limits provided by safety limits, limited control settings, and limiting conditions of operations and to provide requirements that maintained the safety basis of the facility as described in the safety basis documentation. Minimum staffing levels were derived to support normal operations, abnormal operations, and emergency conditions. Design features were derived to describe vital passive components, configuration and physical arrangements where safety was a concern, building materials, and changes to the facility under the Unresolved Safety Question (USQ) process. The TSR derivation process also provided for TSRs that considered interfaces with other WTP facilities and Hanford Site facilities. Interfaces with other facilities included: BOF, off-site power, and radioactive waste transfer lines. The reviewers found this to conform to the requirements of SRD Safety Criterion 9.2-3.

3.5.3 Conclusions

The reviewers concluded that BNI had established a comprehensive TSR derivation process that will ensure safe operation of the WTP facility and will protect the health and safety of the public, workers, and the environment.

3.6 Criticality Safety Program

The purpose of this review was to determine whether the Contractor had implemented an acceptable nuclear criticality safety (NCS) program, including adequate measures to prevent criticality.

3.6.1 Requirements

The requirements for the NCS program are found in DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," which states, "The radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, have been adequately assessed, sufficiently controlled/mitigated, and adequately documented in a formally controlled Preliminary Safety Analysis Report (PSAR) to establish a basis for safe operation and

an unambiguous definition of the safe-operating envelope." Also, DOE/RL-96-0006,[55] Section 4.2.2.5, requires that 'The facility should be designed and operated in a manner that prevents nuclear criticality."

The SRD safety criteria that have been developed to implement these DOE requirements for criticality safety are found in Section 3.3 of the SRD, Volume II. In particular, SRD Safety Criterion 3.3-1 directly incorporates the top-level standard from DOE/RL-96-0006 and requires compliance with DOE O 420.1A as an implementing standard. The requirements found in the SRD criteria, DOE O 420.1A, and the ANSI standards referenced by the Order can be broadly categorized as follows:

1. **NCS Organizational Responsibilities** – The NCS program in the PSAR must establish an organization that has appointed individuals with the responsibility and authority for ensuring NCS.

2. **Management Control Systems for NCS** – The NCS program in the PSAR must commit to administrative controls to ensure NCS in the following programmatic areas: configuration management, maintenance, QA, and training.

3. **NCS Technical Practices** – The PSAR must provide analysis of criticality parameters for hazards and accident scenarios to show that the SRD requirements for criticality prevention are met by the controls that form the basis for NCS in the facility.

3.6.2 Evaluation

The reviewers evaluated information in Chapter 6 of the PSAR, Volume I; 24590-WTP-RPT-NS-01-001, *WTP Criticality Safety Evaluation Report* (CSER); and calculation notes supporting the CSER against the requirements discussed above. The criticality safety information in the PSAR was based on the analysis in Revision 1 of the CSER, which was submitted with the PSAR. The review raised questions with the analysis in CSER, Revision 1. As a result, BNI issued Revision 2 of the CSER. The reviewers concluded that as a result of these changes to the CSER and information provided in response to reviewer questions, additional changes to the CSER are required and Chapter 6 of the PSAR must be revised to make the PSAR and the CSER consistent. In response to Questions PT-PSAR-085, -090, -318, -321, and -322 discussed below, BNI committed to revise the PSAR and CSER with the first revision of the PSAR following authorization for full facility construction to correct these inconsistencies.

The reviewers found two categories to be acceptable and one category to be conditionally acceptable. Details of the evaluation are presented below:

1. **NCS Organizational Responsibilities** – The reviewers found the description of NCS organizational responsibilities in Chapter 6 of the PSAR to be acceptable because they were consistent with the implementing standards of SRD Safety Criterion 3.3.1.

[55] *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.*

Specifically, the PSAR adequately addressed elements of implementing standards ANSI/ANS 8.19-1996, *Administrative Practices for Nuclear Criticality Safety*, and ANSI/ANS 8.1-1983 (R-1988), *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*, requiring organizational positions and functional responsibilities to be described. Also, the reviewers found that the commitments to develop written procedures governing criticality safety adequately addressed the requirements for procedures in ANSI 8.1, recognizing that the procedures are not expected at the preliminary design stage. Reviewers found acceptable commitments to document and correct violations of NCS procedures as required by ANSI 8.19.

2. **Management Control Systems for NCS** – The reviewers found the commitments to NCS-related QA controls referenced in the PSAR to be acceptable because they were consistent with the implementing standards of SRD Safety Criterion 3.3-1. Specifically, software quality control is governed by Section Q-03.2 of 24590-WTP-QAM-QA-01-001, *Quality Assurance Manual* (QAM), and met the requirements of ANSI 8.1 for quality control of criticality safety software. Responsibilities for NCS inspections and audits were described in the PSAR, Chapter 6. Training and qualification requirements were specified in Chapter 6 and satisfied the general requirements for qualification of the Criticality Safety Specialist as required by ANSI 8.19. NCS training programs for operation and management personnel not associated with the NCS organization are not required until final design and operation and were not evaluated.

3. **NCS Technical Practices** – The reviewers found the analysis of criticality parameters and development of criticality controls in the PSAR to be conditionally acceptable because they were consistent with the implementing standards of safety criteria in the SRD, Section 3.3, except as noted below. The overall approach to criticality safety in the submittal consists of the following:

   (a) Fissile material and neutron absorbers in the feed receipt tanks are sampled and analyzed. Sample results are then compared to criticality safety limits (CSLs) to determine whether the feed is acceptable for processing.

   (b) Downstream criticality parameters for all credible normal and accident conditions are analyzed to ensure that the process is safely subcritical given that feed satisfied the CSLs.

   BNI's strategy for criticality safety is to require sampling of the incoming feed to verify it meets the CSLs. The CSLs submitted in the PSAR control the overall concentration of fissile material, uranium enrichment, and the ratio of Pu to certain neutron absorbers (e.g., Mn, Fe, and Ni).

   The reviewers found the scope of normal, off-normal, and accident conditions analyzed in the CSER to be acceptable. The PSAR referred to the CSER for systematic identification of criticality hazards and their analysis. The evaluation provided in the CSER determined that no credible criticality accidents existed. Reviewers found this approach to document criticality hazards acceptable.

During review of the submittal, several concerns were identified relating to the analysis of criticality parameters downstream of the feed receipt tanks (process parameter issues) assuming that feed meets the feed receipt CSLs and was accepted for processing. The evaluation of these issues follows.

SRD Safety Criterion 3.3-2 requires the design to include margins of safety for nuclear criticality commensurate with uncertainties. Reviewers questioned (Questions PT-PSAR-090 and -320) the adequacy of the CSL on the Pu/metals ratio in which neutron absorber ratios are credited in the waste stream. This CSL represented a requirement that the waste feed contain neutron absorbers in proportion to Pu as expressed by the equation:

$$\frac{\text{g of fissionable Pu mass}}{\text{kg of}\left(\text{Fe mass} + 4.000 \times Mn\ mass + 1.524 \times \text{Ni mass}\right)} \leq 6.25$$

The quantity on the left side of the equation was identified in the submittal as the "Pu/Metals Ratio." The CSER did not evaluate the effects of washing and leaching downstream on neutron absorber ratios credited in the analysis. The CSL was applied only in the feed receipt tanks and did not allow margins for loss of neutron absorbers in the process. In response to Questions PT-PSAR-090 and -320, BNI provided additional information analyzing the impact of caustic leaching on the Pu/metals ratio. The analysis calculated the change in absorber ratios due to leaching based on the Best Basis Inventory from the Tank Waste Information Network System (TWINS)[56] characterization database for the processing batches considered in the Phase 1[57] processing. The results showed that the Pu/metals ratio calculated from Best Basis Inventory tank waste data will not increase more than a few percent due to leach factors based on TWINS Best Basis Inventory data. In addition, it was shown that if absorbers in all batches were reduced by applying the largest Best Basis Inventory leach factor for each absorber and for any individual tank in the Phase 1 batches, the Pu/metals ratio would increase no more than 13%. This data suggested that upper bounds on leach factors for each absorber could be applied across the board (e.g., all Phase 1 processing batches) to create a revised CSL for the Pu/metals ratios, which would account for the effects of washing or leaching. In the response to Question PT-PSAR-090, BNI committed to revise the CSL in this manner and include it in the first revision of the PSAR and CSER following authorization for full facility construction. Reviewers found this commitment acceptable because BNI's analysis indicates there is sufficient margin between the current CSL and the actual tank contents so that Phase 1 tank waste could be delivered to the WTP meeting the revised CSL, which will account for washing and leaching.

[56] TWINS (http://twins.pnl.gov:8001/data/data.asp) provides access to a wide variety of Hanford waste tank databases and data sources and to a number of related websites.

[57] Phase 1 processing represents the initial campaign to process Hanford tank waste at WTP. The Phase 1 waste is to be processed to immobilized LAW and immobilized HLW forms by the year 2018 and accounts for 25% of the radioactivity and 10% of the waste mass currently in the Hanford tank farms. The current scope of BNI's WTP Contract includes Phase 1 only.

Reviewers questioned (Question PT-PSAR-321) the analysis for backwashing feed receipt tanks with nitric acid because backwashing could lead to selective removal of neutron absorbers credited in the analysis. SRD Safety Criterion 3.3-2 requires the design to include margins of safety for nuclear criticality commensurate with uncertainties. Accordingly, BNI must show the backwashing operation is safely subcritical. The effect of acid washing on neutron absorbers is discussed in the CSER in Section 7.1.4, which states that acid washing will not preferentially separate Fe, Mn, or Ni from Pu. However, report RPT-W375-TE00044, *Addition of Nitric Acid and Sodium Hydroxide to Hanford Tank Waste*, cited as the basis for this conclusion that further study is required before acid additions can be made to waste from tanks AW-103 and SY-102. The study concluded that plutonium cannot be separated from neutron absorbers by acid additions in all other tanks in the Phase 1 processing plan. In response to the reviewer questions, BNI stated that while backwashing operations are unlikely, insufficient information existed to support the claim that acid backwashing in AW-103 and SY-102 will not violate the CSL on Pu/metals ratio. In the response to PT-PSAR-321, BNI committed to include in the CSER and the PSAR, BNI's analysis showing that backwashing feed from AW-103 and SY-102 will be safely subcritical. Or, if the backwashing feed for AW-103 and SY-102 cannot be shown to be safely subcritical, BNI committed to include in the PSAR, a commitment to establish administrative controls prohibiting backwashing feed from tanks AW-103 or SY-102 with nitric acid. BNI committed to complete this commitment with the first revision of the PSAR after full construction authorization. This commitment was acceptable to the reviewers because it will adequately resolve this deficiency in the CSER analysis before facility operations begin.

The reviewers questioned (Question PT-PSAR-318) the analysis of the fissile material quantity and composition of solids deposited in the melter offgas system. SRD Safety Criterion 3.3-2 requires the design to include margins of safety for nuclear criticality commensurate with uncertainties. Accordingly, BNI must show that any solids that plate-out in the offgas system are safely subcritical. The CSER does not provide a basis for concluding that the composition of material plated-out in the ductwork of the offgas system is safe from criticality hazards. In response to Question PT-PSAR-318, BNI provided additional analysis on the fissile material inventory that could be released into the offgas system. The analysis showed the expected fraction of fissile material in the melter pool released into the offgas system was very small (on the order of 0.001). Thus, the total inventory of fissile material released to the offgas system during all of Phase 1 processing was expected to be on the order of one minimum critical mass of 235-U and one minimum critical mass of 239-Pu. Only a small fraction of the material released to the offgas system is expected to plate-out in the duct-work, and the plate-out would be expected to include various neutron absorbing elements (e.g., boron, iron, and thallium). Based on this additional information, the reviewers concluded there were no credible criticality concerns from plate-out in the melter offgas system. In the response to PT-PSAR-318, BNI committed to include this additional information on the offgas system in the first revision of the PSAR and the CSER. This was acceptable to the reviewers.

Reviewers questioned (Questions PT-PSAR-322, -323, and -324) BNI's analysis of fissile material concentrations and neutron absorber ratios in the solids generated by the

Sr/transuranic precipitation process. SRD Safety Criterion 3.3-2 requires the design to include margins of safety for nuclear criticality commensurate with uncertainties. Accordingly, BNI must show the precipitate composition is safely subcritical. BNI's evaluation of criticality safety of the Sr/transuranic process is based on showing the Pu/Mn mass ratio in the precipitated solids satisfies the Pu/metals ratio CSL discussed above. Reviewers questioned (Question PT-PSAR-323) uncertainties in the chemistry of the precipitation process that could affect Mn levels in the precipitated solids. These uncertainties are not analyzed or discussed in the CSER. In response to Question PT-PSAR-323, BNI provided additional information on the precipitation batch sizes and stated that based on Best Basis Inventory data for Envelope C supernate, which contains the greatest fissile inventory, there was insufficient volume in the ultrafilter feed preparation vessels to contain a critical mass of Pu. The reviewers concluded it would not be credible to combine this small quantity of Pu with the other fissile isotopes (i.e., 233-U and 235-U) in each batch of precipitate in the ultrafilter system such that the subcriticality limit on k_{eff} would be violated given the low 235-U enrichment (~0.7% for the AN-107 Best Basis Inventory data) and the normal precipitation chemistry data in the CSER showing the Pu/Mn mass ratio is approximately one hundred time less than the subcritical limit. In the response to Question PT-PSAR-323, BNI committed to include this additional information on precipitation batch sizes and their Pu content in the first revision of the PSAR and CSER following authorization for full facility construction. The reviewers found this commitment acceptable.

In Appendix A of the CSER, BNI identified the possibility of a sodium diuranate compound forming in the LAW evaporator and the consequent potential for criticality in evaporator deposits. BNI identified this issue because of a criticality concern with uranium-bearing deposits in the H-area evaporator at the Savannah River Site. SRD Safety Criterion 3.3-2 requires the design to include margins of safety for nuclear criticality commensurate with uncertainties. Accordingly, BNI must demonstrate that any potential evaporator deposits are safely subcritical. The reviewers agreed that the presence of 235-U in potential evaporator deposits did not present a criticality concern because it was controlled by the enrichment CSL as stated in the PSAR. However, waste from one tank, C-104, has an unusually high 233-U inventory (~43 kg as opposed to a few hundred grams or less in other tanks) and presents a unique concern for evaporator deposits containing uranium. BNI provided additional information on this issue in the response to Question PT-PSAR-085. In its response, BNI stated that criticality in LAW evaporator deposits was not credible for the following reasons:

1. The LAW evaporator design was different than the H-area evaporator; the LAW evaporator design had a much lower operating temperature and waste flowed through the tube side (1" tubes) of the reboiler (as opposed to the shell side of the H-area evaporator) such that very little volume was available for solids buildup.

2. Even if sodium diuranate compounds did accumulate in the evaporator, the maximum enrichment (in 233-U and 235-U) of the uranium deposits is much lower than the enrichment present in the Savannah River Site waste.

The response provided analysis of criticality parameters for an optimally moderated infinite system of sodium diuranate at the enrichment levels found in the Best Basis Inventory data for tank C-104. BNI's analysis showed k_{eff} to be subcritical (per SRD Safety Criterion 3.3-2) suggesting that actual deposits in the restricted geometry of the 1" evaporator tubes would not pose a criticality concern. BNI committed to include this information in the first revision of the PSAR and the CSER following authorization for full facility construction. The reviewers found this evaluation and commitment acceptable.

3.6.3 Conclusions

The reviewers found BNI's NCS program conditionally acceptable.

Conditions of Acceptance – BNI must complete the following with the first PSAR revision following authorization for full facility construction:

1. Revise the CSL for the Pu/metals ratios, which would account for the effects of washing or leaching, as committed to in the response to Question PT-PSAR-090. (See Section 3.6.2, Item 3.)

2. Include in the CSER and the PSAR an analysis showing that backwashing feed from tanks AW-103 and SY-102 will be safely subcritical. Or, if the backwashing feed for AW-103 and SY-102 cannot be shown to be safely subcritical, include in the PSAR a commitment to establish administrative controls prohibiting backwashing feed from tanks AW-103 or SY-102 with nitric acid, as committed to in the response to Question PT-PSAR-321. (See Section 3.6.2, Item 3.)

3. Include in the PSAR and CSER information on fissile material released and accumulated in the offgas system, as committed to in response to Question PT-PSAR-318. (See Section 3.6.2, Item 3.)

4. Include in the PSAR and CSER information on precipitation batch sizes and their Pu content, as committed to in response to Question PT-PSAR-323. (See Section 3.6.2, Item 3.)

5. Document in the PSAR and CSER the basis for diuranate accumulation in the evaporator system not posing a criticality concern, as committed to in response to Question PT-PSAR-085. (See Section 3.6.2, Item 3.)

3.7 Radiation Protection

The purpose of this review was to determine whether the PSAR adequately described an acceptable radiological control program (RCP) that protected the health and safety of facility and co-located workers and the public. The RCP describes the radiological safety program as it relates to nuclear facility safety and includes the radiation protection program requirements of 10

CFR 835, "Occupational Radiation Protection." The review focused on the PSAR, Volume I, *General Information*, as it related to radiation protection.

The radiological control submittal was acceptable if it addressed the functional elements from draft NRC Regulatory Guide 3.52, as required by the SRD,[58] and if it was consistent with other submittals, including the radiation protection program, the draft submittal of the environmental radiological protection program (ERPP), the draft Deactivation Plan, the Limited Construction Authorization Request (LCAR)[59] and the draft Emergency Response Plan. BNI previously submitted[60] a Radiation Protection Program for design and construction in response to the requirements of 10 CFR 835 and the Contract, Section C, Standard 7, Item (e)(2)(ii), and Table S7-1, and subsequently updated the radiation protection program on December 27, 2001.[61] The radiation protection program, a subset of the RCP, was limited to occupational radiation protection and compliance with the requirements of 10 CFR 835.

3.7.1 Requirements

For the RCP to be acceptable, it should have discussed the 13 functional elements from NRC draft Regulatory Guide 3.52 as identified separately below. Because the RCP is not required until authorization for production operations, many of the sections to be reviewed were in draft.

1. **ALARA (As Low As Reasonably Achievable) Policy –** Policies and procedures used to ensure that radiation exposures will be maintained ALARA were described, as were the organizational structure, ALARA committees, and the application of trending analysis to maintain exposures ALARA.

2. **Organizational Relationships and Personnel Qualifications** – A detailed organizational chart for the RCP was provided, and the qualification requirements for the radiological protection personnel and assignment of specific responsibilities and authorities for key functions were identified.

3. **Radiological Control Procedures and Workplace Controls** – The program was described for identifying, developing, maintaining, and using approved written radiological control procedures and Radiation Work Permits (RWPs) for activities related to radiological control.

4. **Radiological Control Training** – The program to provide radiological control training for all personnel who have authorized access to a controlled area was described. Training objectives, management oversight, training methodology, identification of who is

[58] Appendix G, Section 3.1, "Safety Analysis Report Preparation."
[59] 24590-WTP-LCAR-ESH-01-001, *Limited Construction Authorization Request*.
[60] CCN: 020735, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Authorization Basis Change Notice ABCN-24590-01-00003, 'RPP-Revised Applicability to Include All Activities Performed on the Hanford Site,'" dated June 27, 2001.
[61] CCN: 024508, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Information: Authorization Basis Change Notice 24590-ABCN-ESH-01-024, Rev. 0, Radiation Protection Program (RPP) Document Number and Editorial Changes," 01-OSR-0521, dated December 27, 2001.

required to receive the training, content and frequency of training and refresher training, and training effectiveness also were described. The review of radiological control training was coordinated with the review of the overall performance based training and qualification system, which is described in Section 3.12 of this SER.

5. **Ventilation Systems** – Design of the ventilation systems was described, including specifications of the minimum flow velocity at hood openings, the types of filters and the maximum differential pressure across filters, and the planned frequency and types of tests required to measure ventilation system performance. Ventilation systems were reviewed in Sections 3.2.2 and 4.1.1.2 of this SER rather than in this section. Because of the stage of the WTP project, details on the adequacy of the ventilation systems, such as minimum flow velocities at hood openings and the maximum differential pressure across filters, will be reviewed in a later safety analysis report submittal.

6. **Air Sampling** – Air sampling objectives and procedures for radiological controls were described, including the following:[62]

   (a) Methods for analyzing airborne concentrations

   (b) Methods for calibrating air sampling and counting equipment

   (c) Action levels and alarm setpoints

   (d) Basis used to determine action levels, investigation levels, and derived air concentrations and the minimum detectable activity for the radionuclides

   (e) Frequency and methods of analyzing airborne concentrations

   (f) Counting techniques

   (g) Specific calculations and levels

   (h) Action levels and investigation levels

   (i) Locations of continuous air monitors, if used, and locations of continuous air monitor annunciators and alarms.

7. **Contamination Control** – The program to control radioactive contamination within the facility was described, including the following:[63]

   (a) Types and frequencies of surveys

   (b) Limits for removable and fixed contamination levels

[62] NRC's Draft Regulatory Guide 3.52, Section 5.6, "Air Sampling."
[63] NRC's Draft Regulatory Guide 3.52, Section 5.7, "Contamination Control."

(c) Methods and types of instruments used in the surveys

(d) Action levels and actions to be taken when the administrative controls or other limiting action levels are exceeded

(e) Types and quantities of contamination monitoring equipment

(f) Description of personnel (skin and clothing) contamination limits

(g) Minimum provisions for personnel decontamination

(h) Minimum types of protective clothing

(i) Release criteria for radiologically contaminated material

(j) Technical criteria and levels for defining contamination areas

(k) Requirements for investigating personnel skin or clothing contamination

(l) Requirements for frisking each time personnel exit a posted contaminated area

(m) Criteria for leak checking sealed sources.

8. **External Exposure** – The program for monitoring personnel external radiation exposure was described, including the means to measure, assess, and record radiation dose to individuals. The type, range, sensitivity, accuracy, and frequency for analyzing personnel dosimeters were described. The PSAR committed to participate in the National Voluntary Laboratory Accreditation Program to test dosimeters.

9. **Internal Exposure** – The program for monitoring personnel internal radiation exposure was described, including the means to measure, assess, and record radiation dose to individuals and the following:

(a) Criteria for determining when to monitor an individual's internal exposure
(b) Methods for determining the facility and co-located worker intake
(c) Frequency of analysis
(d) Minimum detection levels
(e) Action levels and actions to be taken based on the results.

10. **Combining Internal and External Dose Equivalents** – The program for combining internal and external dose to demonstrate compliance with the dose limits was described, including the procedure used for assessing an individual's doses according to specific regulatory and contractual requirements.

11. **Respiratory Protection** – The respiratory protection program for radiological controls was described, including the equipment to be used, the conditions under which respiratory protection is required for routine and nonroutine operations, the protection

factors to be applied when respirators are used, and the locations of the facility's respiratory equipment.

12. **Instrumentation** – Requirements for measurement instrumentation for radiological controls were described, including the policy for maintaining and using operating instrumentation. The types of instruments that are available, as well as their ranges, counting mode, sensitivity, alarm setpoints, planned use, and frequency of calibration, were described.

13. **Hazard and Accident Analysis** – Postulated accidents that have radiological consequences for the facility and co-located workers were described. Also described were hazard and accident analysis results, the methodology for assessing the accident consequences, likelihood and risk associated with each accident sequence, controls for preventing or mitigating each accident sequence, and the levels of assurance applied to the controls. The adequacy of the hazard and accident analysis was reviewed in Sections 3.3, 3.4, 3.5, and 4.0 of this SER rather than in this section.

3.7.2 Evaluation

The RCP was described in Chapter 7 of PSAR Volume I. Chapter 7 committed to implement the following documents as part of the RCP:

(a) 24590-WTP-PL-NS-01-001, *Radiological Control Program*

(b) 24590-WTP-RPP-ESH-01-001, *Radiation Protection Program for Design and Construction*

(c) 24590-WTP-MN-ESH-01-001, *Waste Treatment Plant Radiological Control Manual*

(d) 24590-WTP-PL-NS-01-002, *RPP-WTP Occupational ALARA Program*.

The reviewers found the cited text in Chapter 7 of the PSAR to be consistent with the radiation protection program, the draft ERPP, the LCAR, the draft Emergency Response Plan, and the draft Deactivation Plan.

The reviewers asked (Question LAW-PCAR-027) what the basis was for stating that changes to PSAR Volume I, Chapter 7, were not required for the full scope PCAR submittals[64] when Chapter 7 did not identify those elements of the RCP that were required for operation. In Question LAW-PCAR-027, the reviewers also asked where each element was addressed in the reference documentation. The response to Question LAW-PCAR-027 indicated that the attached cross-reference review matrix provided the implementing article(s) for the 13 RCP function elements identified in the draft NRC Regulatory Guide 3.52. The reviewers concluded that 6 of

[64] CCN: 023767, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the River Protection Project – Waste Treatment Plant," dated November 12, 2002, Attachment 4, "Scope of PSAR Chapters Provided to Support PCAR Activities, 'Chapter7.'"

the 13 functional elements were not addressed consistent with the requirements of draft NRC Regulatory Guide 3.52 and have identified the deficiencies as conditions of acceptance.

The reviewers found 6 of the 13 elements of the RCP to be acceptable, 6 to be conditionally acceptable, and 1 (ventilation systems) not required for review. The results of the RCP evaluation are summarized below for the 13 functional elements of an adequate RCP. Many of the functional elements were in draft form because the RCP is not required to be fully in effect until authorization for production operations.

1. **ALARA Policy** – The reviewers found acceptable the commitments to policies and procedures used to ensure that radiation exposures are maintained ALARA. The PSAR committed to develop formal plans and measures to apply the ALARA process to occupational exposures. The WTP Radiological Control Manual (WTP RCM) and WTP occupational ALARA program identified responsibilities of the ALARA committee and the general organizational structure as it related to ALARA. Articles 132, 133, and 134 of the WTP RCM adequately addressed applying trending analysis, radiological performance goals, and radiological performance reports. Although these articles were not specifically cited in the cross-reference review matrix, BNI is committed to implementing them because PSAR Volume I, Section 7.1, commits to the entire WTP RCM, stating, "... other key documents within the Radiological Control Program, and required by the Radiation Protection Program are *Waste Treatment Plant Radiological Control Manual* (24590-WTP-MN-ESH-01-001). . ."

2. **Organizational Relationships and Personnel Qualifications** – The reviewers found the description of organizational relationships and personnel qualifications to be conditionally acceptable. Draft NRC Regulatory Guide 3.52, Section 5.2, "Organizational Relationships and Personnel Qualifications," states, "The application should include a detailed organization chart that shows the Radiation Safety Organization and its relationship to senior plant personnel and other line managers, as well as job descriptions, authorities, and responsibilities of Radiation Safety personnel." Article 141 of the WTP RCM described the general characteristics of the radiological control organization and the relationship with line management. Chapter 6 of the WTP RCM identified qualification requirements for key radiation safety organization personnel. Chapter 17 contained the project organizational chart with a focus on design and construction management organizations. General information on responsibilities for key radiation safety functions was provided. However, a detailed organizational chart that showed the radiation safety organization and its relationship to senior plant personnel and other line managers was not provided. A dedicated radiation safety organization should be established to provide relevant support to line managers and workers. Job descriptions defining specific authorities and responsibilities of radiation safety organization personnel, as specified in draft Regulatory Guide 3.52, Section 5.2, also were not provided. SRD, Appendix G,[65] indicated that the Final Safety Analysis Report (FSAR) will provide organizational charts of the line organization and safety organization as well as a description defining qualifications, responsibilities, and authorities for each position

[65] "Ad Hoc Implementing Standard for Safety Analysis Reports," Table G-2, "Planned Differences Between Regulatory Guide 3.52 PSAR and FSAR Content," Section 2.1, "Organization and Administration."

related to safety. The reviewers agreed with the approach and identified this commitment as a condition of acceptance.

3. **Radiological Control Procedures and Workplace Controls** – The reviewers found the program for identifying, developing, maintaining, and using approved written radiological control procedures and RWPs for activities related to radiological control to be conditionally acceptable. The PSAR committed to use written, approved procedures and RWPs to carry out RCP activities. The QAM, Policies Q-5.1 and Q-6.1, provided policies for reviewing and revising procedures. The WTP RCM identified when RWPs were required, what staff positions may approve RWPs, and what information is to be included in RWPs. However, it did not specify the review and revision cycle of procedures and did not describe the mechanism used for ensuring that RWPs are not used past their termination dates as specified in draft Regulatory Guide 3.52, Section 5.3, "Radiation Safety Procedures and Radiological Work Permits (RWP)." Although this information was not expected to be developed for the PSAR submittal, the review and revision cycle of procedures should be developed and provided to DOE before the start of the preoperational testing phase[66] as a condition of acceptance, and the mechanism used for ensuring that RWPs are not used past their termination dates should be developed and provided in the FSAR.

4. **Radiological Control Training** – The reviewers found the description of radiological control training for all personnel with authorized access to a controlled area to be acceptable. The WTP RCM discussed training objectives, management oversight, training methodology, identification of who is required to receive the training, content and frequency of training and refresher training, and evaluation of training effectiveness as it relates to radiological control. (Training is also discussed in Section 3.12 of this SER.)

5. **Ventilation Systems** – The reviewers found the ventilation system description and policy to be acceptable. The WTP RCM identified the policy that required using engineered controls to limit the intake of radioactive materials, including airflow from areas of lower contamination to areas of higher contamination. Because of the WTP project's preliminary stage, the adequacy of the detailed ventilation system, such as minimum flow velocity at hood openings, will not be determined in this SER but will be reviewed in a later safety analysis report.

6. **Air Sampling** – The reviewers found the air sampling program for radiological control to be conditionally acceptable. The WTP RCM described general requirements for air sampling and actions to be taken when action levels were exceeded. However, it did not adequately describe the following: the methods for analyzing airborne concentrations; methods for calibrating air sampling and counting equipment; action levels and alarm setpoints; the basis used to determine action levels, investigation levels, and derived air concentrations and minimum detectable activities for the radionuclides; the frequency and methods for analyzing airborne concentrations; counting techniques; specific calculations and levels; action levels and investigation levels; locations of continuous air

[66] SRD Safety Criteria 6.0-2 and 6.0-5.

monitors, if used; and locations of annunciators and alarms. Relevant information specific to air sampling should be located in program or safety documentation and referenced in the FSAR. While this level of information was not expected to be developed for the PSAR, it should be developed and provided to DOE in the FSAR as a condition of acceptance.

7. **Contamination Control** – The reviewers found the description of the program to control radioactive contamination within the facility to be conditionally acceptable. The WTP RCM described the types and frequencies of contamination surveys, release criteria for radiological contaminated material, monitoring requirements for personnel contamination, and minimum types of protective clothing. Article 221 of the WTP RCM discussed limits for personnel contamination for both removable and fixed contamination, technical criteria for defining contamination areas, and action levels when contamination limits are exceeded. Article 325 provided requirements on personal protective equipment and clothing. Appendix 3D provided guidelines for personnel contamination monitoring with hand-held instruments. Article 431 identified the requirements for leak testing sealed sources. Articles 222, 541, and 542 addressed minimum provisions for personnel decontamination and requirements for investigating personnel skin and clothing contaminations. Article 551 discussed general monitoring requirements. Although these articles were not specifically cited in the cross-reference review matrix, BNI committed to contamination monitoring and control and to the entire WTP RCM in its submittal.[67, 68]

To confirm that radiological survey commitments identified in Section 4.0, "Radiological Safety," of the LCAR were still in effect, the reviewers submitted questions LAW-PSAR-213 and PT-PSAR-236. In response, BNI reaffirmed the radiation safety commitment addressed in the LCAR to a radiological contamination control program for the WTP during all phases of design, construction, and preoperational testing. This program confirms that radiological conditions have not changed and ensures that if radioactive contamination is detected, it will be appropriately controlled. As stated in BNI's response, procedures that address construction site response to off-normal radiological conditions have been developed.

To protect the worker and the public, previous conditions from the Limited Construction Authorization Agreement,[69] namely, "The radiological surveys, potential radiological contamination control and remediation activities, and the use of industrial radioactive sources as described in the LCAR, Section 4.0, 'Radiological Safety,'" will remain in effect in the Construction Authorization Agreement.

[67] CCN: 017637C (01-OSR-0025J), CHG letter from J. O. Honeyman to W. J. Taylor, ORP, "Response to the Office of Safety Regulation Questions Regarding the Radiation Protection Program, Revision 5A,"dated January 24, 2001.
[68] CCN: 018020C (01-OSR-0050), CHG letter from J. O. Honeyman to W. J. Taylor, ORP, "Responsibility for Progression of the Radiological Protection Program for Design and Construction, Revision 5A is Transferred from CH2M Hill Hanford Group, Inc., to Bechtel National Inc.," dated February 12, 2001.
[69] 01-OSR-0509, ORP letter from R. C. Barr to R. F. Naventi, BNI, "River Protection Project – Waste Treatment Plant (RPP-WTP) Limited Construction Authorization Agreement, Revision 1," dated December 20, 2001.

The facility's design features for controlling contamination were described in the PSAR. However, the PSAR did not adequately identify the types and quantities of contamination monitoring equipment and the methods and types of instruments used in the radiation surveys. Although this information was not expected to be developed for the PSAR submittal, it should be developed and provided to DOE in the FSAR as a condition of acceptance.

8. **External Exposure** – The reviewers found acceptable the commitments for monitoring personnel external radiation exposure, including the means to measure, assess, and record radiation dose to individuals. Article 512.1 of the WTP RCM committed to PNL-MA-842, *Hanford External Dosimetry Technical Basis Manual*, which describes the type, range, sensitivity, accuracy, and frequency for analyzing personnel dosimeters. The WTP RCM committed to having an external dose monitoring program that is accredited by the Department of Energy Laboratory Accreditation Program for personnel dosimetry, which is equivalent to the NRC's National Voluntary Laboratory Accreditation Program.

9. **Internal Exposure** – The reviewers found the commitments for monitoring personnel internal radiation exposure, including the means to measure, assess, and record radiation dose to individuals, to be acceptable. The WTP RCM described the criteria for determining when to monitor an individual's internal exposure, action levels, and actions to be taken based on results. Article 522.1 of the WTP RCM committed to PNNL-MA-860, *Methods and Models of the Hanford Internal Dosimetry Program*, and PNL-MA-552, *Hanford Internal Dosimetry Project Manual*, which described the methods for determining worker intake; frequency of analysis; sensitivity and minimum detection levels; frequency of measurements; criteria for participation; and methods for determining worker intake from airborne radioactivity measurements, *in vivo* bioassay, *in vitro* bioassay, or a combination of these methods.

10. **Combining Internal and External Dose Equivalents** – The reviewers found acceptable the program for combining internal and external dose to demonstrate compliance with the dose limits, including the procedures used for assessing individual doses according to specific regulatory and contractual requirements.

11. **Respiratory Protection** – The reviewers found the respiratory protection program to be conditionally acceptable. The WTP RCM described equipment to be used and the conditions under which respiratory protection was required for routine and nonroutine operations and committed to ANSI Z-88.2-1992, *American National Standard for Respiratory Protection*, which provides the protection factors to be applied when respirators are used. The WTP RCM and ANSI Z-88.2-1992 provided the requirements for training, control, use of respiratory equipment, mask fit testing, and breathing air purity. The PSAR described types of engineering and administrative controls that have been implemented to reduce the risk of internal exposure. However, the PSAR did not provide the locations of the facility's respiratory equipment. Although this information was not expected for the PSAR, it should be developed and provided to DOE in the FSAR as a condition of acceptance.

12. **Instrumentation** – The reviewers found the instrumentation program to be conditionally acceptable. The WTP RCM provided the policy for maintaining and using operating instrumentation and committed to ANSI N323, *Radiation Protection Instrumentation Test and Calibration*, which provides performance testing and calibration requirements. However, it did not adequately describe the radiation measurement selection criteria for performing radiation and contamination surveys, sampling airborne radioactivity, monitoring area radiation, and performing radiological analyses. The submittal did not list the types and quantities of instruments that were available, as well as their ranges, counting mode, sensitivity, alarm setpoints, and planned use, nor did it describe instrument storage, calibration, and maintenance facilities and laboratory facilities used for radiological analyses. The cross-reference review matrix indicated that not all instrumentation has been determined for the project. Although this information was not expected to be developed for the PSAR, it should be developed and provided to DOE in the FSAR, as a condition of acceptance.

13. **Hazard and Accident Analysis** – The adequacy of the hazard and accident analysis was not reviewed in this section but was evaluated in Sections 3.3, 3.4, 3.5, and 4.0 of this SER.

3.7.3 Conclusions

Based on a review of the PSAR and BNI's response to Question LAW-PCAR-027 concerning radiological controls, the reviewers concluded that the RCP was conditionally acceptable. The PSAR committed to an RCP that protects the health and safety of the facility and co-located workers and the public. The PSAR was consistent with other submittals, including the documented radiation protection program, the draft submittal of the ERPP, the LCAR, the draft Emergency Response Plan, and the draft Deactivation Plan.

Conditions of Acceptance – BNI must include the following provisions in the RCP. Except for Item 2 below, these provisions should be provided with the FSAR:

1. Provide a detailed organizational chart that shows the radiation safety organization and its relationship to senior plant personnel and other line managers; also, provide job descriptions defining specific authorities and responsibilities of radiation safety personnel. (See Section 3.7.3, Item 2.)

2. Specify the review and revision cycle of procedures and provide to DOE before the start of the preoperational testing phase. (See Section 3.7.3, Item 3.)

3. Describe the mechanism for ensuring that RWPs are not used past their termination dates. (See Section 3.7.3, Item 3.)

4. Describe the methods for analyzing airborne concentrations; methods for calibrating air sampling and counting equipment; action levels and alarm setpoints; the basis used to determine action levels, investigation levels, and derived air concentrations and minimum detectable activities for the radionuclides; the frequency and methods for analyzing

airborne concentrations; counting techniques; specific calculations and levels; action levels and investigation levels; locations of continuous air monitors, if used; and locations of annunciators and alarms. (See Section 3.7.3, Item 6.)

5. Identify the types and quantities of contamination monitoring equipment and the methods and types of instruments used in the radiation surveys. (See Section 3.7.3, Item 7.)

6. Identify the locations of the facility's respiratory equipment. (See Section 3.7.3, Item 11.)

7. Describe the radiation measurement selection criteria for performing radiation and contamination surveys, sampling airborne radioactivity, monitoring area radiation, and performing radioactive analyses. List the types and quantities of instruments that were available, as well as their ranges, counting mode, sensitivity, alarm setpoints, and planned use. Describe the instrument storage, calibration, and maintenance facilities and laboratory facilities used for radiological analyses. (See Section 3.7.3, Item 12.)

3.8 Hazardous Material Protection

The purpose of this review was to determine whether the PSAR adequately implemented, or committed to implement, hazardous material protection to control chemicals that pose hazards other than radiological hazards to the workers and the environment. The program should describe the organization, policies, and philosophy to demonstrate that an acceptable hazardous material protection program exists for the WTP.

This hazardous material protection review does not include the scope of the process chemical safety program. Chemical process safety and process hazards analyses, chemical process accident sequences, and potential consequences for hazardous materials are addressed for each WTP facility in the respective Sections 4.1.2, 4.2.2, and 4.3.2 of this SER.

3.8.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item A.8, contains the requirements for hazardous material protection, stating that the Contractor must submit a PSAR containing the following: "Analysis of radiological, nuclear, and process hazards for design." The SRD contains related requirements for the hazardous material protection, including the following specific safety criteria: 1.0-1 through 1.0-4 , 1.0-6 through 1.0-8, 3.1-1 through 3.1-8, 4.0-1 through 4.0-3, 4.1-1, 4.2-2, 4.4-4, 6.0-1, 6.0-2, 6.0-5, 7.0-1 through 7.0-3, 7.1-2, 7.2-3 through 7.2-8, 7.3-10, 7.3-11, 7.6-2, 7.6-4, 7.7-1 through 7.7-3, 7.8-1, 7.8-2, and 7.8-5.

The regulatory bases for WTP hazardous materials protection are set forth in 29 CFR 1910.119, "Occupational Safety and Health Act of 1970, Process Safety Management of Highly Hazardous Chemicals," to the extent that highly hazardous chemicals are present in regulated quantities, and in EPA 550-F-99-010, *The General Duty Clause*, when the chemicals either are not listed in the regulations or are below threshold quantities or concentrations.

RL/REG-99-05 did not provide guidance for reviewing the hazardous material protection section. Therefore, DOE-STD-3009-94, Chapter 8, "Hazardous Material Protection," was used for the review. BNI had previously been authorized to use DOE-STD-3009-94 as the format for preparing its safety analysis reports.[70] Chapter 8 identifies the following areas for inclusion in a hazardous materials protection program:

1. Hazardous material protection and organization
2. ALARA policy and program
3. Hazardous material training
4. Hazardous material exposure control
5. Hazardous material monitoring
6. Hazardous material protection instrumentation
7. Hazardous material protection recordkeeping
8. Hazard communication program
9. Occupational chemical exposures.

3.8.2 Evaluation

Hazardous material protection was described in PSAR Volume I, Chapter 8, and was evaluated for relevant process safety principles and elements of a process safety management program. The reviewers found the commitments in Chapter 8 on hazardous material protection to be acceptable. Chemical process safety and process hazards analyses, chemical process accident sequences, and potential consequences for hazardous materials were described in Chapter 3 of each facility-specific volume of the PSAR and were evaluated in the corresponding sections of Chapter 4 of this SER.

The evaluation of the information for each area identified in Chapter 8 of DOE-STD-3009-94 is summarized below:

1. **Hazardous Material Protection and Organization** – The reviewers found the PSAR commitments defining the role and structure of the Industrial Health and Safety (IH&S) organization and the commitment to an IH&S organization to be acceptable. PSAR Volume I, Section 8.3, cited the *Nonradiological Worker Safety and Health Plan* (24590-WTP-PL-IS-01-001), as BNI's commitments in this area. The reviewers found the PSAR commitments to be acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.3, "Hazardous Material Protection and Organization," were identified and adequately addressed in PSAR Section 8.3 and in the *Nonradiological Worker Safety and Health Plan*.

2. **ALARA Policy and Program** – The reviewers found the commitment in PSAR Volume I, Section 8.4, to use best industrial processes to be acceptable. The reviewers noted that ALARA policy was not applicable to nonradiological hazardous material

[70] 02-OSR-0034, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of Bechtel National, Inc. (BNI) Authorization Basis Change Notice, ABCN-24590-01-00004, Rev. 2, 'Identification of Safety Analysis Report (SAR) Format and Content,'" dated January 29, 2002.

protection. The reviewers found this to be consistent with DOE-STD-3009-94, Section 8.4, "ALARA Policy and Program," which states that for hazardous materials ALARA needs to be considered a qualitative concept evaluated against the Occupational Safety and Health Administration's and industrial hygiene exposure standards and guidelines. The reviewers found the PSAR commitments to be acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.4, were identified and adequately addressed in PSAR Section 8.4.

3. **Hazardous Material Training** – The reviewers found the PSAR commitments for hazardous material training to be acceptable. For both employees and subcontractors PSAR Volume I, Section 8.5, committed to the chemical safety and hazardous material training provisions of PSAR Volume I, Section 12, and 24590-WTP-PL-TR-01-002, *Training and Qualification Plan (Draft).* The reviewers found the PSAR commitments to be acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.5, "Hazardous Material and Training," were identified and adequately addressed in PSAR Section 8.5 and 24590-WTP-PL-TR-01-002.
Section 3.12 of this SER includes additional evaluation of BNI's training program.

4. **Hazardous Material Exposure Control** – The reviewers found the PSAR commitments to hazardous material exposure control to be acceptable. PSAR Volume I, Section 8.6, stated that best chemical-industry practices would be used for hazardous material exposure control. The PSAR described a program for identifying hazardous materials and the elements of a process safety management program for developing and applying administrative limits to hazardous materials consistent with the *General Duty Clause*. Elements of this program were evaluated as follows:

   (a) **Hazardous Material Identification Program** – The reviewers found the PSAR commitments for a hazardous material identification program to be acceptable. The PSAR stated that 24590-WTP-RPT-ESH-01-001, *Determination of Extremely Hazardous Substances*, would be used for identifying extremely hazardous substances.[71] PSAR Section 8.6.1 stated that each extremely hazardous substances chemical would be included in the facility authorization basis, while nonextremely hazardous substances chemicals will be managed according to standard industry practices for the public and the worker. The PSAR stated that chemicals used in laboratories would be managed according to 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories." The reviewers found the PSAR commitments to be acceptable because the program requirements of DOE-STD-3009-94, Section 8.6.1, "Hazardous Material Identification Program," were identified and adequately addressed in PSAR Section 8.6.1 and 24590-WTP-RPT-ESH-01-001.

[71] Extremely hazardous substances are any chemical listed in 40 CFR 68, "Chemical Accident Prevention Provisions," or any other chemical that may as a result of short-term exposures because of releases to the air cause death, injury, or property damage because of their toxicity, reactivity, flammability, volatility or corrosivity. [Clean Air Act Amendments of 1990, Section 112(r)(1)].

(b) **Administrative Limits** – The reviewers found the PSAR commitments for administrative limits to be acceptable. The PSAR described a process safety management program with 12 elements that matched the program elements identified in DOE/RL-96-0006,[72] Section 5.2, "Administrative Limits,"; and in RL/REG-99-05, Section 7.0, "Chemical Process Safety." (All 12 elements of a process safety management program are contained in specific safety criteria in Sections 3, 4, 6, and 7 of the SRD.) The guidance in Section 7.2 of RL/REG-99-05 stated that some elements of the chemical process safety program are more appropriately addressed during operations authorization. The reviewers evaluated the elements that should be in place for the CAR review and found the commitments made in PSAR Volume I, Section 8.6.2, for the 12 elements for chemical process safety and hazardous material protection acceptable for construction authorization.

Several process safety program elements identified in Section 8.6.2 were demonstrated by commitments to programs described in other sections of PSAR Volume I and were evaluated in other sections of this SER:

- Section 3.3.2 for process hazards analysis (see Section 3.3 of this SER)
- Section 12.4 for employee, contractor, and subcontractor training (see Section 3.12 of this SER)
- Chapter 10 for mechanical integrity and preventive maintenance (see Section 3.10 of this SER)
- Section 17.4.6 for managing change and the USQ process (see Section 3.17 of this SER)
- Section 17.4.7 for incident investigation (see Section 3.17 of this SER)
- Section 17.4.2 for compliance audits (see Section 3.17 of this SER).

(c) **Occupational Medical Programs** – The reviewers found the PSAR commitments for occupational medical programs to be acceptable. PSAR Volume I, Section 8.6.3, committed to having an onsite medical facility staffed with qualified, licensed medical personnel to treat injuries and to provide physicals, evaluations, and medical tests. BNI's occupational medical program was previously reviewed for adequacy as part of the inspection to assess the IH&S program implementation and to support the authorization of initial limited construction activities. The IH&S Inspection Report[73] noted one deficiency related to the occupational medical program that was corrected before the start of

[72] *DOE Process for Radiological, Nuclear, and Process Safety Authorization, Verification, and Confirmation of the RPP Waste Treatment Plant Contractor*.
[73] 01-OSR-0398, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Industrial Health and Safety Inspection Report, IR-01-005," dated November 16, 2001.

limited construction activities. The PSAR committed to the occupational medical program for full facility construction. The reviewers found this commitment acceptable. The PSAR commitments in Section 8.6.3 were acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.6.3, "Occupational Medical Programs," were identified and adequately addressed, and existing programs were incorporated and committed to providing adequate occupational medical protections for hazardous materials.

(d) **Respiratory Protection and Personal Protective Equipment** – The reviewers found the PSAR commitments to respiratory protection and personal protective equipment to be acceptable. PSAR Volume I, Section 8.6.4, committed to using respiratory protection to protect workers when engineering or administrative controls were not feasible or until such controls could be implemented. Personnel protective equipment will also be used as needed, and workers will be trained in their proper use and care. BNI's respiratory protection program and personal protective equipment program were previously reviewed as part of the inspection to assess the IH&S program. The IH&S Inspection Report noted implementation deficiencies related to the fall protection program that were corrected before limited construction activities. The PSAR committed to the respiratory protection program and personal protective equipment program for full facility construction and therefore was acceptable.

5. **Hazardous Material Monitoring** – The reviewers found the PSAR commitments to hazardous material monitoring to be acceptable. PSAR Volume I, Section 8.7, committed to using National Institute of Occupational Safety and Health methodology to sample and monitor the workplace to evaluate potential exposures to dust, noise, and chemicals. These commitments were acceptable to the reviewers. The IH&S Inspection Report[74] noted deficiencies related to the industrial hygiene monitoring and surveying equipment that were corrected before limited construction activities. The PSAR committed to the industrial hygiene program, including hazardous material monitoring, for full facility construction and therefore was acceptable. The PSAR commitments were also consistent with the program elements and information required by DOE-STD-3009-94, Section 8.7, "Hazardous Material Monitoring."

6. **Hazardous Material Protection Instrumentation** – The reviewers found the PSAR commitments to hazardous material protection instrumentation to be acceptable. PSAR Volume I, Section 8.8, provided only limited information while committing to using direct-reading instruments in conjunction with sample collection for laboratory analysis to monitor the hazardous materials. Oxygen and nitrous oxide monitors will also be installed in appropriate locations. The IH&S Inspection Report for limited construction noted deficiencies related to the industrial hygiene monitoring and surveying equipment that were corrected before the start of limited construction activities. The PSAR committed to the industrial hygiene program, including hazardous material protection instrumentation for full facility construction. The reviewers found the PSAR

[74] 01-OSR-0398, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Industrial Health and Safety Inspection Report, IR-01-005," dated November 16, 2001.

commitments to be acceptable and consistent with the program elements and information required by DOE-STD-3009-94, Section 8.8, "Hazardous Material Protection Instrumentation."

7. **Hazardous Material Protection Recordkeeping** – The reviewers found the PSAR commitments to hazardous material protection recordkeeping to be acceptable. PSAR Volume I, Section 8.9, committed to using a recordkeeping and reporting process, such as OSHA 200 Log and Summary of Occupational Injuries and Illnesses and the First Reports of Injuries. The PSAR stated that employees will have access to their records, and that injuries and illnesses will be reported to DOE according to Contract requirements. (Documentation submittal requirements for nonradiological worker safety and health are specified in Section C, Standard 7, Item (e)(1) of the Contract.) The IH&S Inspection Report noted one deficiency related to industrial hygiene exposure that was corrected before the start of limited construction activities. The PSAR committed to the worker protection program, including industrial hygiene exposure assessment records and reports for full facility construction. The reviewers found the PSAR commitments to be acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.9, "Hazardous Material Protection Recordkeeping," were identified and adequately addressed in PSAR Section 8.9.

   Section 3.17 of this SER includes additional evaluation of BNI's records management program.

8. **Hazard Communication Program** – The reviewers found the PSAR commitments to a hazardous communication program to be acceptable. PSAR Section 8.10 committed to communicating health hazards and industrial hygiene concerns to the workforce and to updating the communication as new hazards are identified. Task-specific hazard mitigation will also be included in the pretask job briefings. BNI's hazard communication program was previously reviewed for adequacy as part of the inspection to assess the IH&S program and to support the authorization of initial limited construction activities and found to be acceptable. The PSAR committed to the hazard communication program for full facility construction. The reviewers found the PSAR commitments to be acceptable because the program elements and information required by DOE-STD-3009-94, Section 8.10, "Hazard Communication Program," were identified and adequately addressed in PSAR Section 8.10.

9. **Occupational Chemical Exposures** – The reviewers found the PSAR commitments to control occupational chemical exposures to be acceptable. PSAR Section 8.11 stated that potential occupational chemical exposures to workers were discussed in Chapter 3 of each facility-specific volume, relative to potential accident conditions specific to each facility. Although the potential exists for WTP employees to be exposed to hazardous materials above the allowable limits, BNI will use industrial hygiene controls, facility-specific engineered and administrative controls, and personnel sampling to ensure that such overexposure does not occur. This commitment was acceptable to the reviewers and consistent with the program elements and information required by DOE-STD-3009-94, Section 8.11, "Occupational Chemical Exposures."

In this SER, Sections 4.1.2, 4.2.2, and 4.3.2 include additional evaluation of the analyses of potential occupational chemical exposures for the LAW, HLW, and PT facilities, respectively.

3.8.3 Conclusions

The reviewers concluded that the PSAR commitments would acceptably implement hazardous material protection for the LAW, HLW, and PT facilities. The PSAR committed to integrating and implementing hazardous material protection.

3.9 Waste Management

The purpose of this review was to determine whether the PSAR described an acceptable radioactive and hazardous waste management program that protected the workers, the public, and the environment. The review considered PSAR Volume I, Section 9. Radioactive and hazardous waste management is also closely associated with the ERPP, as discussed in Section 5.9 of this SER.

3.9.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," contains the requirements for waste management, stating the following about the CAR submittal: "a demonstration that adequate protection of the public, the workers, and the environment *should* be achieved [emphasis added]," and "a description of facility features and functions provided to control the radiological, nuclear, and process hazards." Related requirements for the radioactive and hazardous waste management program are also found in the SRD, Section 5.3, "Environmental Radiation Protection," and Section 5.4, "Environmental Radiological Monitoring." The SRD contains specific safety criteria requirements applicable to the review on waste management and environmental protection in Sections 2.0, 5.3, and 5.4, and Safety Criterion 9.0-1.

The WTP must also meet federal and State of Washington requirements regarding handling and disposal of Resource Conservation Recovery Act of 1976 (RCRA) waste. To comply with RCRA, a *Dangerous Waste Permit Application* (DWPA) (24590-WTP-DWPA-ENV-01-001) was prepared for the treatment facility and will be incorporated into the Hanford Site dangerous waste permit.[75]

The PSAR for waste management and environmental protection was acceptable if the following criteria from RL/REG-99-05, Section 10.3.3.1, "Environmental Protection," were addressed:

[75] *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*.

1. **Effluent Control** – BNI identified and described adequate physical design features and administrative controls to control the release of radioactive and nonradioactive materials (e.g., gaseous, liquid, and solid) into the environment.

2. **Effluent Monitoring** – BNI identified and described adequate physical design features and administrative controls to monitor the release of radioactive and nonradioactive materials (e.g., gaseous, liquid, and solid) into the environment.

3. **Waste Management** – BNI identified and described an adequate waste management program that manages the generation, handling, storage, and disposal of general, hazardous, dangerous, and radiological waste.

4. **Effluent and Waste Minimization** – BNI identified and described adequate engineering and administrative policies that will minimize the generation of effluents and general, hazardous, dangerous, and radiological waste.

5. **Environmental Monitoring** – BNI identified and described an environmental monitoring program so as to reasonably ensure that the effluent monitoring program is adequate and that effluent discharges are within regulatory requirements.

6. **Environmental Impact Assessment** – BNI identified and described adequate environmental monitoring program complemented with environmental modeling methodologies (i.e., computer models) that will appropriately assess environmental impacts.

7. **Regulatory Compliance** – BNI identified and described an integrated process of effluent control and monitoring, environmental monitoring, and environmental impact assessment to demonstrate regulatory compliance.

8. **Provisions for Continuing Assurance** – BNI identified and described a method for continuing assurance for environmental protection by integrating environmental protection into organization and administration, training and qualification, maintenance and surveillance, audits and assessments, and QA.

3.9.2 Evaluation

The reviewers evaluated information provided in PSAR Volume I, Chapter 9. Relevant references in the submittals were also reviewed to assess the scope and breadth of the waste management program. In addition, responses to questions relative to waste management were reviewed.

Questions LAW PSAR-010 and -123 requested information on how each safety criteria for environmental protection was addressed and correlated to other documents referenced in PSAR Volume I and in the draft ERPP. In response, BNI identified elements of the Environmental Protection Program as being implemented in the draft ERPP and submitted a cross-reference review matrix, "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," which

addressed the questions raised by these reviewers. The documents cited by BNI for nonradioactive waste management were the same documents as for radioactive waste management, indicating that this is how the integration of radioactive and non-radioactive waste is addressed.

BNI identified many environmental compliance documents that implement radiological environmental requirements and integrate nonradiological requirements:

- *Radioactive Air Emissions Notice of Construction Permit Application for the River Protection Project - Waste Treatment Plant (RPP-WTP)* (24590-WTP-RPT-ENV-01-008)

- *Dangerous Waste Permit Application* (24590-WTP-DWPA-ENV-01-001)

- *Products and Secondary Wastes Plan* (24590-WTP-PL-RT-02-001)

- *State of Washington Waste Discharge Permit No. ST 4502*.

Although many of these documents were not directly cited in PSAR Volume I, Chapter 9, they were incorporated through references to the draft ERPP (see Section 5.9 of this SER) and in the responses to questions LAW PSAR-010 and LAW-PSAR-123. As stated in Section 9.7, "Environmental Radiological Protection Plan," of PSAR Volume I, "For those requirements not addressed elsewhere, the ERPP will describe how the requirements are satisfied." ORP accepted BNI's reliance on other documentation. The reviewers accepted BNI's explanation concerning how each criterion was addressed and correlated.

The reviewers found the description of the waste management program, coupled with the description of the draft ERPP, acceptably addressed all eight review criteria. The evaluation of the information for each review criterion is summarized below:

1. **Effluent Control** – The reviewers found acceptable BNI's identification and description of physical design features and administrative controls that should control release of radioactive and nonradioactive materials (e.g., gaseous, liquid, and solid) into the environment. .

2. **Effluent Monitoring** – The reviewers found acceptable BNI's identification and description of physical design features and administrative controls that should monitor the release of radioactive and nonradioactive materials (e.g., gaseous, liquid, and solid) into the environment.

3. **Waste Management** – The reviewers found acceptable BNI's identification and description of its waste management program that should manage the generation, handling, storage, and disposal of general, hazardous, dangerous, and radiological waste for the WTP design. In addition, BNI developed an environmental plan[76] for construction

[76] 24590-WTP-PL-ENV-01-004, *River Protection Project – Waste Treatment Plant Environmental Plan*.

activities that compiled various procedures to address, among other things, construction generated wastes. The plan was approved by ORP[77] and described the strategy for compliance with various environmental regulations, including RCRA, and identified applicable procedures, such as the following:

- 24590-WTP-GPP-SENV-005, *Waste Designation*
- 24590-WTP-GPP-SENV-007A, *Dangerous Waste Accumulation & Handling*
- 24590-WTP-GPP-SENV-006, *Packaging Non-Radioactive Dangerous Waste and Material for Recycle*
- 24590-WTP-GPP-SENV-008, *Pollution Prevention/Waste Minimization*

4. **Effluent and Waste Minimization** – The reviewers found acceptable BNI's identification and description of the engineering and administrative policies that should minimize the generation of effluents and general, hazardous, dangerous, and radiological waste.

5. **Environmental Monitoring** – The reviewers found acceptable BNI's identification and description of an environmental monitoring program that should ensure that effluent discharges are within regulatory requirements.

6. **Environmental Impact Assessment** – The reviewers found acceptable BNI's identification and description of an environmental monitoring program complemented with environmental modeling methodologies (i.e., computer models) that should appropriately assess environmental impacts.

7. **Regulatory Compliance** – The reviewers found acceptable BNI's identification and description of an integrated process of effluent control and monitoring, environmental monitoring, and environmental impact assessment that should demonstrate regulatory compliance. In Question LAW-PSAR-011, the reviewers requested additional information on how radiological and nonradiological environmental protection requirements (including the safety criteria) were being integrated for the WTP. In response, BNI provided adequate information explaining how integration of radiological and nonradiological protection requirements were being ensured and proposed additional text for the draft ERPP that was responsive to the question.

8. **Provisions for Continuing Assurance** – The reviewers found acceptable BNI's identification and description of a method for continuing assurance for environmental protection by integrating environmental protection into organization and administration, training and qualification, maintenance and surveillance, audits and assessments, and QA.

[77] 02-AMIC-040, ORP letter from M. K. Barrett to R. F. Naventi, BNI, "Deliverable 7.3 Environmental Plan," dated February 13, 2002.

3.9.3 Conclusions

The reviewers concluded that the PSAR described an acceptable radioactive and hazardous waste management program that protected the workers, the public, and the environment. The program should provide for safe control, collection, and handling of waste generated during operation of the WTP facilities. In responses to questions LAW-PSAR-010, -011, and -123, BNI committed to integrate radioactive and nonradioactive waste management.

3.10 Initial Testing, In-Service Surveillance, and Maintenance

The purpose of this review was to determine whether the PSAR adequately described a commitment to a thorough testing program, including a preoperational testing program that described the planned testing of ITS equipment. The PSAR was expected to describe the purpose of each test, the expected data, and the test and associated equipment. Because of the preliminary stage of design, detailed information was not expected to be available concerning all tests.

3.10.1 Requirements

The initial testing program submittal was acceptable if the following criteria were met:

1. A preoperational testing program was developed to demonstrate that ITS SSCs have been properly constructed and can perform their specified functions. The program should include supplier testing, construction testing, and startup testing and should provide for detecting, tracking, and correcting deficiencies (SRD Safety Criterion 6.0-1).

2. A system for validating procedures for normal facility and systems operation and for functional tests to be performed during the operating phase was developed as part of the preoperational testing program (SRD Safety Criterion 6.0-2).

3. Detailed diagnostic data on systems and components designated as ITS will be collected during preoperational testing (SRD Safety Criterion 6.0-3).

4. The as-built operating characteristics of process systems and systems and components designated as ITS are documented during the preoperational testing program (SRD Safety Criterion 6.0-4).

5. The implementing code and standard for the initial testing program is the SRD, Appendix J, "Ad Hoc Implementing Standard for Startup (pending)."

3.10.2 Evaluation

The reviewers found PSAR Volume I, Section 10, to be acceptable. In addition, the reviewers evaluated the conformance of the test program described in the PSAR to the subordinate standard

for testing specified in the SRD, Appendix J, "Ad Hoc Implementing Standard for Startup."[78] The WTP's preliminary design did not provide sufficient information for BNI to develop detailed information about specific equipment and system tests and the bases for them.

The PSAR committed to developing and implementing a commissioning test program to confirm that SDC, SDS, and other significant facility SSCs were properly built and will operate as designed, within safety limits, before transitioning to the operational phase. The testing program will be implemented using a phased approach that will take individual components and items of equipment and systems through progressive levels of testing. Testing phases will include construction testing (vendor tests and installation checks); system commissioning; integrated tests with water; cold commissioning using chemicals, reagents, and simulants; and hot commissioning using active waste in compliance with SRD Safety Criterion 6.0-1.

The PSAR also committed to developing a WTP commissioning transition plan that will describe the overall safety, technical, and management philosophy of the WTP testing program. The Startup Manual will be derived from this plan and will incorporate the requirements of the QAM for testing, personnel qualifications, and record management. The manual will require test plans to be developed to outline test objectives, prerequisites, precautions, and acceptance criteria and will be derived from design criteria, process descriptions, and engineering specifications. In addition, the manual will provide for control and resolution of test deficiencies, control of test changes, system and process fault tracking and resolution, and evaluation of test data. The Startup Manual and test plans meet the requirements of SRD Safety Criterion 6.0-2.

In addition to providing test controls, the Startup Manual will require and prescribe methods for collecting and recording test data. The manual will also describe the qualifications and duties of the Joint Test Group, whose responsibilities will include review and approval of (1) test plans before their use, (2) test procedures before their use, (3) results of completed tests, (4) major changes to approved test procedures, and (5) reports of the commissioning results. This meets the requirements of SRD Safety Criterion 6.0-3. The reviewers considered BNI's commitment to include Joint Test Group review and approval of commissioning results reports as conservative, in that the "Ad Hoc Implementing Standard for Startup" (the SRD, Appendix J, requires the separate Commissioning Review Board to both review and approve cold and hot commissioning tests and their results.

With the exception of construction testing, in each testing phase, the PSAR committed to validating operating and maintenance procedures and instructions and revising them based on test results in compliance with SRD Safety Criterion 6.0-2. During cold commissioning tests, baseline operating data for all major facilities will be established in compliance with SRD Safety Criterion 6.0-3. Hot commissioning tests will establish additional baseline operating data not obtained in previous testing phases in compliance with SRD Safety Criterion 6.0-4.

The PSAR committed to performing readiness reviews before commencing cold commissioning and again before commencing hot commissioning. Although the objectives and scope of these

[78] CCN: 035819, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Transmittal for Information: Page Changes for Integrated Safety Management Plan Revision 1g, and Safety Requirements Document, Revision 1h, per U.S. Department of Energy Approval of Authorization Basis Change Notices," dated October 10, 2002.

reviews is somewhat different, each will be performed by independent BNI assessors. The PSAR committed to having the Project Safety Committee approve the results of the readiness review for hot commissioning and certifying to ORP that the project was ready for operation with active waste.

From a comparative review of Section 10.1 through 10.3 of the PSAR to the "Ad Hoc Implementing Standard for Startup" (the SRD, Appendix J), the reviewers concluded the test program described in the PSAR conformed to the requirements of this implementing code and standard for testing and included all of its elements.

3.10.3 Conclusions

The reviewers concluded that the description of the initial testing program in PSAR Volume I, Section 10 was acceptable. The PSAR committed to a thorough initial testing program that contained all the required elements to ensure that the design, construction, hardware, programs, and personnel will be ready to support safe facility operation.

3.11 Operational Safety

The purpose of this review was to determine whether the PSAR adequately described an operational safety program for the facilities' safe operations. The operational safety program is closely coupled with the Conduct of Operations (CONOPS) Plan, which was submitted in draft form by BNI, and is assessed in Section 5.4 of this SER.

3.11.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item 18b, contains the requirements for the draft operational safety program, stating, in part, that the Contractor shall submit a "draft Conduct of Operations Plan," which complies with the current authorization basis and describes the operational practices to be used. Other requirements include SRD Safety Criterion 7.0-1, which states, "Normal operations shall be conducted in accordance with approved operational safety requirements and in strict accordance with administrative and procedural controls."

The SRD, Safety Criterion 7.5-2, requires the basic elements of an operational safety program to be described and include the following 19 program areas:

1. Operations organization and administration
2. Shift routines and operating practices
3. Control area activities
4. Communications
5. Control of on-shift training
6. Investigation of abnormal events
7. Notifications
8. Control of equipment and system status

9. Lockout and tag out
10. Independent verification
11. Log keeping
12. Operations turnover
13. Operations aspects of facility chemistry and unique processes
14. Required reading
15. Timely order to operations
16. Operations procedures
17. Operator aid posting
18. Equipment and piping labeling
19. Emergency operating procedures for dealing with responses to accident conditions.

3.11.2 Evaluation

The reviewers evaluated PSAR Volume I, Section 11, which described the 19 basic elements necessary for an operational safety program, and found it to be acceptable. The reviewers compared the description of operational safety with the description and details of the same elements in the draft CONOPS Plan (see Section 5.4 of this SER). Although there were slight differences in the level of detail and information presented between Section 11 of the PSAR and the draft CONOPS Plan, each complements the other. One aspect of the operational safety section of the PSAR that was not covered in detail in the draft CONOPS Plan involved the timing of implementation of various program elements. For example, Section 11.3.8 of the PSAR discussed control of equipment and system status and stated that this element of the draft CONOPS Plan would be implemented at the beginning of the project's commissioning phase. The reviewers considered the stated timing of implementing the elements of operational safety to be acceptable.

3.11.3 Conclusions

The reviewers concluded that Volume I, Section 11 of the PSAR adequately described an operational safety program for safe operation of the WTP facilities in that it (1) closely paralleled the information in the draft CONOPS Plan that was accepted, with specific commitments for inclusion in the final plan, in Section 5.4 of this SER and (2) provided acceptable information about the phased timing of implementing various program elements in support of commissioning and operations. The reviewers concluded that the description of the operational safety program was acceptable.

3.12 Procedures and Training

The purpose of this review was to determine whether the PSAR adequately described the implementation of an acceptable procedures program that included a commitment to develop, review, control, and implement written procedures that adequately protect the facility and co-located workers, the public, and the environment during the partial and early construction activities. The review was also to determine whether BNI had defined an acceptable training and

qualification program to reasonably ensure that site personnel have the knowledge and skills to perform the partial and early construction activities in a manner that adequately protects the health and safety of the workers. The review considered the PSAR, Volume I, *General Information*, as it related to procedures and training.

3.12.1 Requirements

The requirements for procedures and training are identified separately below.

Procedures – Section 3.5, "Procedures," of RL/REG-99-05 outlines the requirements for procedures. The submittal on procedures was acceptable if it met the following criteria:

1. Procedures were written or planned, as appropriate, for conducting operations involving controls identified in the preliminary safety analysis as ITS items and for all management control systems supporting those controls.

2. Management control procedures exist or were planned, as appropriate, to manage the following activities:

   (a) Configuration management
   (b) Radiation safety
   (c) Maintenance
   (d) Human factors
   (e) QA
   (f) Training and qualification
   (g) Audits and assessments
   (h) Incident investigations
   (i) Records management
   (j) Nuclear criticality safety
   (k) Fire safety
   (l) Chemical process safety
   (m) Reporting requirements
   (n) Emergency management
   (o) Environmental protection.

3. Methods for identifying, developing, approving, implementing, and controlling operating procedures were described.

4. The types of procedures that will be used were described and the areas requiring a procedure were clearly identified. These areas typically include management control, operating, maintenance, and emergency procedures. The submittal listed (in an appendix) the types of activities that are covered by written procedures.

5. The methods by which procedures will be reviewed and revised were described, as needed, following unusual incidents, such as an accident, significant operator error, equipment malfunction, or any system modifications.

6. The methods by which procedures were verified to be technically accurate and could be performed as written were described. The individuals responsible for verification were identified.

7. Issuance and distribution of procedures were documented and referred to the records management function.

8. The use and control of procedures were described.

Training – Section 3.4, "Training and Qualification," of RL/REG-99-05 outlines the requirements for training. The draft Training and Qualification Plan and the description of the training program were acceptable if they met the following criteria:

1. BNI demonstrated that it was organized, staffed, and managed to facilitate planning, directing, evaluating, and controlling a systematic training process that fulfilled job-related training needs. A graded approach to training based on the results of the site hazard and accident analysis was in effect.

2. The training program provided for periodic retraining, based on specific criteria. Procedures for including operating experience feedback into the training program were described.

3. Minimum requirements were specified for selecting trainee candidates who perform actions relied on to prevent or mitigate accident sequences described in the hazard and accident analysis.

4. The tasks required for competent and safe job performance were identified, documented, and included in the training.

5. Learning objectives that identify training content and define satisfactory trainee performance were derived from job performance requirements.

6. Lesson plans and other training guides provided guidance and structure to ensure that training activities will be conducted consistently and were based on the required learning objectives derived from specific job performance requirements.

7. Information was provided on evaluating trainees periodically during training to determine their progress toward mastering job performance requirements.

8. On-the-job training, if used for activities required by the hazard and accident analysis, was fully described.

9. A systematic evaluation of training effectiveness and its relation to on-the-job performance was used to ensure that the training program conveyed the required skills and knowledge and to revise the training, where necessary, based on the performance of trained personnel in the job setting.

10. A mechanism was used to ensure that feedback on unsafe practices, root cause investigations, and other operational human errors related to safety is integrated into continuing qualification training plans or special training sessions.

3.12.2 Evaluation

The results of the reviewers' evaluation of procedures and training are summarized separately below.

Procedures – The reviewers found three of the eight criteria were acceptably met and five were conditionally met. The procedures program was described in PSAR Volume I, Section 12.3. In addition to the eight review areas, the evaluation included the program for the design and construction phase procedures as well as the program for the proposed operational phase procedures. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the procedure program to be acceptable for conducting operations involving controls identified in the PSAR as ITS items and for all management control systems supporting those controls. Administrative procedures relating to design, analysis, and construction of the LAW and HLW structures were reviewed and documented in ORP Inspection Report IR-01-013, *Safety Requirements Document Design Standards Implementation*. The procedure program met requirements. In addition, BNI had implemented a formal process to develop, implement, and control procedures for design and construction activities associated with the LAW, HLW, and PT facilities. BNI had also adequately described its planned program for developing, maintaining, controlling, and implementing procedures for the WTP's operating phase.

2. The reviewers found the management control procedures to be conditionally acceptable. The PSAR committed to working according to established management controls during design, engineering, and construction by implementing a Procedures Management System, which is part of the ISM system. In addition, in response to Question LAW-PCAR-103 concerning which management control procedures were in place, BNI committed to revising Section 12.3.1.1 as follows: "The project readiness assessment process determines the procedure set required to support Construction activities. Procedures are developed and issued before the activity governed by the procedure takes place." In response to the same question, BNI also committed to providing a table in Section 12.3.1.1 to indicate which activities were being addressed in management control procedures during design and construction, cold commissioning, and hot commissioning and operations. As committed to in its response to Question LAW-PCAR-103, Section 12.3.1.1 should be revised with the first PSAR revision following authorization for full facility construction.[79]

3. The reviewers found the methods for identifying, developing, approving, implementing, and controlling operating procedures to be acceptable. The PSAR adequately described

[79] Full facility construction means construction of the LAW, HLW, PT, and BOF facilities (excluding the Analytical Laboratory).

its planned operations phase procedures program in Section 12.3.1.2, its planned operations phase procedure development in Section 12.3.2.2, and its planned operations phase procedure maintenance in Section 12.3.3.2. Specifically, the PSAR committed to providing procedures for a defined task or activity that accomplishes work or for activities defined in the QAM, authorization basis, or requirements documents. These procedures will incorporate applicable regulatory requirements and provide an auditable, traceable implementation of requirements. Procedures will be reviewed by affected departments and have identified owners. The procedure owner organization will perform a final assessment before procedures are approved to ensure compliance with requirements and management expectations. Procedure control will be provided by the Project Administration Document Control Department, which will allow WTP personnel access to controlled, current versions of approved procedures.

4. The reviewers found the identification of the types of procedures that will be used and the areas requiring a procedure to be conditionally acceptable. As noted in Item 2 above, BNI committed to revising Section 12.3.1.1 to specifically state the management control procedures that are or will be in place to support the design and construction phase activities under the PSAR. In addition, in response to Question LAW-PCAR-106 concerning how procedures would be identified during the cold and hot commissioning stages, BNI committed to revising Section 12.3.2.2 as follows: "The procedures covering the following topics are in place as needed for the construction phase of the project. Changes and additions to the procedure set will be identified before cold commissioning and scheduled for completion before the activity taking place: major management control systems, system and facility operations (including control of hazardous processes), major maintenance activities (including safe work practices), hazardous materials control activities, radiological control activities, and emergency response activities (including radiological and hazardous chemical release)." As committed to in its response to Question LAW-PCAR-106, Section 12.3.2.2 should be revised with the first PSAR revision following authorization for full facility construction.

5. The reviewers found the description of the methods for reviewing and revising procedures to be acceptable. Throughout Section 12.3, the PSAR committed to review and revise procedures using a formal methodology. In Section 12.3.1.1, the PSAR indicated that updates, corrections, or improvements to the approved procedures are accomplished through user feedback. The management assessment and corrective action programs provide mechanisms for continuous improvement of both the procedures and the procedure process. In Section 12.3.3.1, the PSAR indicated that feedback and continuous improvement are integrated in the procedure management program through various processes, including lessons learned, procedure change processes, management and self-assessments, periodic reviews, independent assessments, corrective actions, post-job briefs, and audits. In Section 12.3.2.2, the PSAR indicated that the need for a new or revised procedure may be identified under the following circumstances: when implementing modifications in conducting an operation, when modifying equipment or systems, when deeming a procedure inadequate during task performance, and when periodically reviewing technical procedures. The PSAR also indicated in Section 12.3.3.2.1 that procedure modifications can result from issues identified during training

activities and from efforts to resolve occurrences resulting from personnel errors or equipment.

6. The reviewers found the methods by which procedures were verified as technically accurate and could be performed as written to be conditionally acceptable. The PSAR described the methods for verifying that procedures were technically accurate and able to be performed as written, including stipulating the types of individuals responsible for verifying that procedures meet appropriate standards and expectations. In Section 12.3.1.1 on design and construction phase procedures and in Section 12.3.1.2 on operational phase procedures, the PSAR committed to having the identified owner organization perform a final assessment before approval to ensure procedures were technically accurate and consistent with management expectations. The PSAR also committed that, before they are used by the end user, operational phase procedures (new and revised) will be validated, usually at the work location, to ensure their usability and correctness and that technical review and verification will ensure the technical accuracy of operational phase procedures by comparing them against appropriate source documents.

   In response to Question LAW-PCAR-104 concerning approval of WTP project procedures, BNI committed to revising Section 12.3.1.1 as follows to clarify who can approve procedures: "The procedure process is governed by the project procedure on procedures. It requires that management associated with ES&H [environment, safety, and health] and QA review new procedures and concur that they are or are not within the AB [authorization basis]. ES&H and QA review changes to existing procedures if they affect the AB or QA requirements. At a minimum, management associated with the relevant safety disciplines concurs with new procedures and changes to existing procedures that affect the AB requirements." As committed to in its response to Question LAW-PCAR-104, Section 12.3.1.1 should be revised with the first PSAR revision following authorization for full facility construction.

7. The reviewers found the description of documenting the issuance and distribution of procedures and referral to the records management function to be conditionally acceptable. The PSAR committed to forming the Project Administration Document Control Department to provide a controlled delivery system that allows WTP personnel access to controlled, current versions of approved and released procedures. This delivery system will be electronic and will include an index that lists all approved procedures by title, number, and revision. In Section 12.3.1.2, the PSAR stated that line management would be responsible for supplying controlled copies of procedures and instructions at work locations and training workers on identifying and using the correct procedure revision. The procedure user is responsible for ensuring that the procedure to be used is the most current. In Section 12.3.2.2, the PSAR committed to implementing a process that ensures that WTP administrative and technical procedures are assigned a procedure and revision number, a record copy is placed in a procedure master file, and working and controlled copies of procedures are made available to procedure users. In response to Question LAW-PCAR-107 concerning the procedure change program and for consistency with the QAM, BNI committed to add the following language to Sections 12.3.3.1 and 12.3.3.2.1: "The project procedure complies with the WTP QAM and

addresses permanent procedure revisions and expedited procedure changes." As committed to in its response to Question LAW-PCAR-107, Sections 12.3.3.1 and 12.3.3.2.1 should be revised in the first PSAR revision following authorization for full facility construction.

8. The reviewers found the description for using and controlling procedures to be conditionally acceptable. The PSAR committed to specific intervals for reviewing selected procedures to ensure that they remain technically accurate and appropriately human-factored. The specified frequency for periodic review is based on the safety importance of the procedures (e.g., procedures related to operation and maintenance of ITS SSCs and procedures related to implementing TSR requirements). In Section 12.3.1.2, the PSAR committed to implementing administrative procedures that will require procedure users to stop work if the work cannot be accomplished as described in the procedure or if accomplishing the work would result in an undesirable situation. In addition, this section committed to developing and using a protocol (e.g., a "classification code") for using technical procedures that includes designating procedures for use as "step-by-step" or "general intent." In response to Question LAW-PCAR-105 concerning use of technical procedures, BNI also committed to adding the following to Section 12.3.1.1: "For construction activities, the basic work planning process is based on the concept that for standard construction tasks, step-by-step work instructions are not required. A combination of technical specifications, field procedures and drawings are utilized to perform the work. Individuals involved in the work are trained to the requirements. The work is planned using a construction administrative procedure addressing construction work packages. When unique or complex tasks are performed, work planning is addressed in a construction administrative procedure addressing special instruction work packages. This procedure provides for the use of a work package with additional controls, including, where appropriate, step-by-step instructions." As committed to in its response to Question LAW-PCAR-105, Section 12.3.1.1 should be revised in the first PSAR revision following authorization for full facility construction.

Training – The reviewers found 5 of the 10 criteria to be acceptable and 5 to be conditionally acceptable. The training and qualification program was described in PSAR Volume I, Chapter 12.4 and in the Draft Training and Qualification Plan. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the description of the training system's organization and management to be acceptable. The PSAR committed to establishing a training department to plan, coordinate, and implement a training program for permanent and temporary positions that perform ITS work. The training program was supported by written procedures that apply to all WTP personnel and subcontractor employees. Responsibilities were defined for personnel involved in implementing the training program. Task-specific training and assessments were provided for manual and non-manual workers. A systematic approach to training (SAT), including needs and job analysis, was used to determine training needs and objectives.

2. The reviewers found the commitments to provide periodic retraining and the procedures for including operating experience feedback to be acceptable. The PSAR committed to

provide refresher training that complies with periodic training requirements specified in applicable federal and state regulations and to maintain required certifications. Training will include provisions for lessons learned and operating experience feedback. Line managers will be responsible for the content and effective conduct of the training and qualification programs. Training records will be maintained according to Project Document Control procedures.

3. The reviewers found the description of trainee selection to be acceptable. The PSAR specified minimum requirements for selecting trainee candidates and committed to hire people who are qualified by education, training, and experience. All managers will be responsible for developing job specific training and minimum education and experience requirements.

4. The reviewers found the commitments to conduct needs/job analysis and to identify training tasks to be conditionally acceptable. The PSAR committed to identifying, documenting, and including tasks required for job performance in training. The PSAR also committed to using the SAT and linking tasks selected for training to supported procedures and training materials. The training department and subject matter experts will work together to create course material and recommend the instruction method. Training will be modified or developed in a timely manner to respond to changing policy or procedures. A process to maintain WTP training materials current will track items that may affect the content of training programs and materials, including the job task analysis for positions affected by the changes. The training and development program will be systematically evaluated. However, the PSAR did not adequately define the periodic basis for comparing training materials with the list of tasks selected for training. The final training program should be revised to define the periodic basis for comparing training materials with the tasks to be performed. This should be done with the first PSAR revision following authorization for full facility construction as a condition of acceptance.

5. The reviewers found the commitments to develop learning objectives as the basis for training to be conditionally acceptable. The PSAR committed to implementing learning objectives developed under the SAT. Course content will be based on course objectives developed by line management, subject matter experts, and the training department. The training programs will be structured commensurate with specific position needs. However, the learning objectives did not clearly state the knowledge, skills, and abilities the trainee must demonstrate and that learning objectives were sequenced based on their relationship to one another. The PSAR also did not adequately state the conditions under which required actions will take place and the standards of performance the trainee should achieve when completing the training. The final training program should be revised to correct these deficiencies with the first PSAR revision following authorization for full facility construction as a condition of acceptance.

6. The reviewers found the instructing organization's commitments to use lesson plans and other training guides to be conditionally acceptable. The PSAR committed to using lesson plans or equivalent training guides for in-class and on-the-job training. Course content, including lesson plans and briefing guides, will be based on course objectives

developed by line management, subject matter experts, and the training department. Training and qualification procedures will establish processes that project personnel use for conducting training and qualification programs. Qualification of personnel includes the trainee's demonstrating skills and testing. However, the PSAR did not adequately define review and approval requirements for lesson plans, training guides, and other training materials before they are issued and used. The final training program should be revised to correct this deficiency with the first PSAR revision following authorization for full facility construction as a condition of acceptance.

7. The reviewers found the commitments to evaluate trainees' mastery of learning objectives to be acceptable. The PSAR committed to evaluate trainees, to provide task-specific training and assessments, and to evaluate trainee mastery by administering written tests or demonstrating skills and knowledge presented in the classroom. An on-the-job item will not be completed until the trainee has demonstrated mastery of the item.

8. The reviewers found the commitments to conduct on-the-job training to be conditionally acceptable. The PSAR committed to conducting on-the-job training using organized performance-based training materials and to derive on-the-job training cards from task lists that will be updated as required. Trainee mastery will be evaluated by qualified on-the-job training instructors observing trainees' demonstration of skills and knowledge during actual job performance and by trainees demonstrating skills and knowledge presented in the classroom. However, the PSAR did not adequately demonstrate that when the actual task cannot be performed and is walked-through, the conditions of task performance, references, tools, and equipment reflect the actual task to the extent possible. The final training program should be revised with the first PSAR revision following authorization for full facility construction as a condition of acceptance.

9. The reviewers found the commitments to systematic evaluation of training effectiveness to be conditionally acceptable. The PSAR committed to systematically evaluating training effectiveness and to having qualified individuals evaluate the training. Feedback from trainee performance during training and student course critiques will be used to evaluate and refine the training program. Changes will be monitored for their impact on training programs; and training will be modified or developed in a timely manner to respond to sources of feedback, changing requirements, and changing policies or procedures. However, the PSAR did not adequately demonstrate that it had established a defined, periodic basis for conducting training program evaluations. The final training program should be revised to correct this deficiency with the first PSAR revision following authorization for full facility construction as a condition of acceptance.

10. The reviewers found the commitments to integrate feedback in training to be acceptable. The PSAR committed to ensure that feedback on unsafe practices, root cause investigations, and other operational human errors related to safety will be integrated into continuing qualification training plans or special training sessions. The training department and line management will respond to feedback from the configuration management system, quality program, and self-assessment activities to ensure personnel involved in the WTP project achieve and maintain the capabilities required to perform their assigned tasks safely. Performance-based training will be based in part on feedback

from operational experience, lessons learned, and industry experience. Training will be modified or developed in a timely manner to respond to sources of feedback. Continuing training will include training in applicable industry operating experience with emphasis on knowledge and skills necessary to ensure safety.

3.12.3 Conclusions

The conclusions from the reviewers' evaluation of procedures and training are summarized separately below.

Procedures – The reviewers concluded that the procedure program was conditionally acceptable. The PSAR described acceptable methods for identifying, developing, approving, implementing, and controlling operating procedures.

Conditions of Acceptance – BNI must complete the following changes to Section 12.3 of Volume I of the PSAR with the first PSAR revision following authorization for full facility construction:

1. Revise Section 12.3.1.1 to state that, "The project readiness assessment process determines the procedure set required to support Construction activities. Procedures are developed and issued before the activity governed by the procedure takes place." Provide a table in Section 12.3.1.1 to indicate which activities are being addressed in management control procedures during design and construction, cold commissioning, and hot commissioning and operations.

2. Revise Section 12.3.2.2 to state, "The procedures covering the following topics are in place as needed for the construction phase of the project. Changes and additions to the procedure set will be identified before cold commissioning and scheduled for completion before the activity taking place: major management control systems, system and facility operations (including control of hazardous processes), major maintenance activities (including safe work practices), hazardous materials control activities, radiological control activities, and emergency response activities (including radiological and hazardous chemical release)."

3. Revise Section 12.3.1.1 as follows to clarify who can approve procedures: "The procedure process is governed by the project procedure on procedures. It requires that management associated with ES&H and QA review new procedures and concur that they are or are not within the authorization basis. ES&H and QA review changes to existing procedures if they affect the authorization basis or QA requirements. At a minimum, management associated with the relevant safety disciplines concurs with new procedures and changes to existing procedures that affect the authorization basis requirements."

4. Add the following to Sections 12.3.3.1 and 12.3.3.2.1: "The project procedure complies with the WTP QAM and addresses permanent procedure revisions and expedited procedure changes."

5. Add the following to Section 12.3.1.1: "For construction activities, the basic work planning process is based on the concept that for standard construction tasks, step-by-step work instructions are not required. A combination of technical specifications, field procedures, and drawings are utilized to perform the work. Individuals involved in the work are trained to the requirements. The work is planned using a construction administrative procedure addressing construction work packages. When unique or complex tasks are performed, work planning is addressed in a construction administrative procedure addressing special instruction work packages. This procedure provides for using a work package with additional controls, including, where appropriate, step-by-step instructions."

Training – The reviewers concluded that the training and qualification description and the draft Training and Qualification Plan were conditionally acceptable. The PSAR committed to obtaining and maintaining a well-qualified staff and to having a performance-based training process. Implementing the described training program should result in staff who are qualified and competent to design and construct the facility safely.

Conditions of Acceptance - BNI must complete the following changes to Section 12.4 of Volume I of the PSAR with the first PSAR revision following authorization for full facility construction:

1. Define the periodic basis for comparing training materials with the list of tasks selected for training.

2. Clearly state in the learning objectives the knowledge, skills, and abilities the trainee must demonstrate; that learning objectives are sequenced based on their relationship to one another; the conditions under which required actions will take place; and the standards of performance the trainee should achieve when completing the training.

3. Define review and approval requirements for lesson plans, training guides, and other training materials before they are issued and used.

4. Demonstrate that when an actual task cannot be performed and is walked-through, the conditions of task performance, references, tools, and equipment reflect the actual task to the extent possible.

5. Define the periodic basis for conducting training program evaluations.

3.13 Human Factors

The purpose of this review was to determine whether the PSAR adequately described BNI's implementation of human factors for designing the facility, process, and equipment.

3.13.1 Requirements

SRD Safety Criterion 1.0-7 requires that to compensate for potential human and equipment failures, a defense-in-depth strategy shall be applied to the facility's design and operation commensurate with the hazards and this strategy. SRD Safety Criterion 3.1-3 requires that the process hazard analysis address, among other things, human factors. SRD Safety Criterion 4.3-6 requires that the possibility of human error in facility operations be taken into account in the design by facilitating correct decisions by operators and inhibiting wrong decisions and by providing the means for detecting and correcting or compensating for error.

RL/REG-99-05, Section 3.5.3.3, "Regulatory Acceptance Criteria," provides further guidance on human factors and stated that the Contractor's description of human factors was acceptable if it met the following criteria:

1. The accident sequences were described in which human errors were causes and where operator actions were credited as safeguards.

2. The human-system interfaces for supporting human actions required to prevent, detect, and correct conditions that could be initiators or contributing factors to accidents were described.

3. The human-system interfaces for supporting human actions required to mitigate the consequences of accidents were described.

4. The submittal explained how human factors engineering related problems and issues encountered in previous designs that were similar to the proposed design under review were identified and reviewed for relevance.

5. The submittal explained how the SRD implementing codes and standards, particularly IEEE 1023-1988, *Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Systems*, were used in designing the human-system interfaces and how human factors considerations were taken into account.

6. The submittal explained how appropriate human factors considerations were or will be integrated into management control systems, such as training, maintenance, and management of change in the drafts of the USQ Plan, the CONOPS Plan, the Training and Qualification Plan, the Maintenance Implementation Plan (MIP), and the Emergency Response Plan.

3.13.2 Evaluation

The reviewers found the human factors program, as described in PSAR Volume I, Chapter 13, and in the ISMP, Section 3.12, "Human Factors," to be conditionally acceptable. Five criteria were acceptably met, and one criterion was conditionally met.

The reviewers found that the treatment of human factors demonstrated adequate implementation of human factors engineering in design and was commensurate with the preliminary design. The PSAR provided information on the human factors that could affect safety, descriptions of the human-system interfaces, and the implementation of the SRD codes and standards BNI had adopted for treating human factors. The evaluation of the information for each requirement is summarized below:

1. The reviewers found acceptable the PSAR's and ISMP's demonstration that human errors were considered in the accident analysis. The PSAR stated that human factors were included in developing of accident sequences in the PSAR. For the LAW facility, human aspects contributed to the severity of offgas release and entry into the melter gallery and C3 areas adjacent to the process cell accidents. For the HLW facility, human error was determined to be the dominant contributor to worker dose from contamination spread from a melter overpack accident and direct radiation from an unshielded canister or group of unshielded canisters accident. For the PT facility, vessel overflow, cesium ion exchange column events, and loss of contamination control were determined to have human error contributions to the severity of the accidents.

2. The reviewers found acceptable the PSAR's and ISMP's demonstration that human-system interfaces for supporting human actions to prevent, detect, and correct conditions that could be initiators or contributing factors to accidents had been identified. The ISMP committed to ensure that human factors and ergonomics were used at every interface between operating personnel and the facility. Instruments and controls in the control room will be placed to ensure that clear indications of facility status will be available to the operators. The ISMP also committed to have human factors specialists conduct human factors reviews of training, operator capabilities, and workspaces.

3. In Chapter 3 of the respective facility PSARs , the reviewers found that the PSARs acceptably described the human-system interfaces intended to support human actions required to mitigate the consequences of accidents.

4. The reviewers found acceptable the PSAR commitment to conduct reviews of similar facilities for human factors engineering lessons learned. ISMP, Section 3.12, committed that human factor specialists would conduct interviews with operations personnel from similar facilities to identify lessons-learned relative to human-machine interfaces. The ISMP also committed to use information from incident databases to identify where human-machine interfaces were contributing factors in recorded incidents.

5. The reviewers found conditionally acceptable the PSAR explanation of how the codes and standards, particularly IEEE 1023-1988, were used in designing the human-system interfaces and how human factors considerations were taken into account. Volume I of the PSAR; SRD Safety Criterion 4.3-6; and the SRD, Appendix B, Section 2.6, "Human Aspects," committed to implementing IEEE 1023-88 for human factors. However, the PSAR did not adequately describe how human factors considerations specified in IEEE 1023-1988 were applied. The PSAR did not describe in sufficient detail the fundamental considerations of human factors engineering, tasks, environment, equipment, personnel, nuclear and chemical operations, and documentation to demonstrate the 22 steps of IEEE

2023-1998 were applied on an integrated systems approach to the WTP design, operations, and maintenance process. In response to Question LAW-PSAR-210 concerning application of IEEE 1023-1988, BNI committed to implement a Human Factors Implementation Plan following IEEE 1023-1988, Section 6, "Implementation in the Design, Operations, Testing, and Maintenance Process." This commitment is a condition of acceptance for approval of the human factors submittal and should be completed with the first PSAR revision following authorization for full facility construction.

6. The reviewers found acceptable the commitment to address ergonomic requirements of facility operations and maintenance as presented in the SRD, Appendix B, Section 2.6, "Human Aspects." Appendix B considered the following human factor elements: equipment labeling, workplace environment (e.g., temperature and humidity, lighting, noise, vibration, and aesthetics), human dimensions, operating panels and controls, component arrangement, warning and annunciator systems, and communication systems, which will be applied to facility operations and maintenance. Elements of human factors engineering were also included in drafts of the following plans: the USQ Plan, the CONOPS Plan, the Training and Qualification Plan, the MIP, and the Emergency Response Plan.

3.13.3 Conclusions

The reviewers concluded that the implementation of human factors was conditionally acceptable. BNI committed to incorporating human factors engineering into the design, operations, and maintenance of the WTP. Implementing the described human factors program should result in human-system interfaces that support human actions required to prevent, detect, and correct conditions that could be initiators or contributing factors to accidents and to safely operate and maintain the WTP facility.

Condition of Acceptance - BNI must complete the following action with the first PSAR revision following authorization for full facility construction:

1. As committed in the response to Question LAW-PSAR-210, implement a Human Factors Implementation Plan following SRD Safety Criterion 4.3-6 and the SRD Appendix B (Section 2.6), which require use of IEEE 1023-1988, Section 6, "Implementation in the Design, Operations, Testing, and Maintenance Process." (See Section 3.13.2, Item 5.)

3.14 Quality Assurance

The purpose of this review was to determine whether the PSAR adequately described the implementation of an acceptable QA program for items and activities ITS for construction, with particular emphasis on ensuring that the QAM had been developed according to the requirements of 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements." This review was specific to the PSAR Volume I, *General Information*, as it related to QA.

3.14.1 Requirements

The Contract, Standard 7, "Environmental, Safety, Quality, and Health," Section (e)(3), contains the requirements for the QAM, requiring the WTP Contractor to use a technically defensible graded approach to develop the QA program. The purpose of the review was to determine whether the submittal adequately described the QA program to be used during construction. Separate review guidance was issued for the QAM: RL/REG-96-01, *Guidance for Review of the RPP-WTP Contractor Quality Assurance Program*. ORP has approved BNI's QAM for construction.

3.14.2 Evaluation

The reviewers found the PSAR description of the QA program to be acceptable based on BNI's referral to its previously approved QAM. The QAM meets the requirements of 10 CFR 830, Subpart A, Revision 0, was approved for design and construction by ORP on September 23, 2002.[80]

3.14.3 Conclusions

The reviewers determined that PSAR description of the QA program was acceptable.

3.15 Emergency Preparedness

The purpose of this review was to determine whether the PSAR adequately established an integrated emergency preparedness program to protect the facility and co-located workers, the public, and the environment and complied with regulatory and authorization basis requirements. Emergency preparedness describes BNI's management of incidents, accidents, and operational occurrences and its commitment to emergency preparedness. The requirements for the emergency preparedness program are complementary to the requirements for an Emergency Response Plan (see Section 5.3 of this SER), so the review guidance for both are closely related.

3.15.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item E, contains the requirements for emergency management, stating that the Contractor is to submit a draft Emergency Response Plan with its request for construction authorization. Section 9.0, "Emergency Management," and Section I, "Draft Emergency Response Plan," of RL/REG-99-05 provide guidance on the emergency preparedness. The emergency preparedness section of the PSAR was evaluated using the criteria for emergency preparedness.

[80] 02-OSR-0453, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Deliverable 7,2, 'Quality Assurance Manual' – 24590-WTP-QAM-01-001, Revision 1," dated September 23, 2002.

Table S7-1 of the BNI Contract requires a draft Emergency Response Plan at start of construction. Table S7-1 also requires the Emergency Response Plan to comply with the requirements of DOE/RL-94-02, *Hanford Emergency Management Plan*, as well as with 40 CFR 68; 40 CFR 355, "Emergency Planning and Notification"; 29 CFR 1910.38, "Employee Emergency Plans and Fire Protection Plans"; and WAC 246-247, "Radiation Protection–Air Emissions." The requirements in these latter documents are in either DOE/RL-94-02 or in a template generated for Hanford contractors, *Building Emergency Plan Generic Template* (HNF-IP-0263-GEN). The template stated that a Building Emergency Plan is used to demonstrate compliance with emergency preparedness planning requirements at hazardous facilities, as defined in DOE/RL-94-02.

RL/REG-99-05 references SRD Safety Criteria 7.8-1 through 7.8-5 and the ISMP, Section 1.3.18, "Emergency Planning," and Section 3.10, Emergency Preparedness," as the applicable safety criteria and implementing codes and standards.

However, on October 19, 2001,[81] BNI submitted an ABCN that proposed to delete Safety Criteria 7.8-2 through 7.8-5 and replace them with DOE/RL-94-02. Also, Safety Criterion 7.8-1 was revised to include the DOE/RL-94-02 criteria as requirements for emergency preparedness. ORP approved the ABCN on June 18, 2002,[82]; this was consistent with Table S7-1 of the Contract that required the Contractor to comply with the requirements of DOE/RL-94-02. Therefore, this review included DOE/RL-94-02 requirements for the evaluation.

RL/REG-99-05, Section 9.3.3, "Regulatory Acceptance Criteria," provided guidance on the 14 elements of an emergency preparedness program. Except for element 1, "Hazard Assessment," the elements were also listed in DOE/RL-94-02. The submittal on emergency management was acceptable if it met the following criteria, as found in Section 9.3.3 of RL/REG-99-05:

1. **Hazard Assessment** – An adequate hazard assessment was used to design the emergency preparedness program.

2. **Emergency Response Organization** – An emergency response organization defined with clear roles that were commensurate with the conclusions of the hazards assessment and are adequate to manage and control emergency response at the facility.

3. **Offsite Response Interfaces** – Commitments from outside organizations were obtained to provide data and services to satisfy safety obligations and coordinated its emergency preparedness with the DOE Hanford Site and local community emergency response plans.

[81] CCN: 023762, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Approval: Authorization Basis Change Notice 24590-WTP-ABCN-ESH-01-003, Rev. 0, 'Selection of Implementing Standard for Emergency Preparedness,'" dated October 19, 2001.

[82] 02-OSR-0232, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Approval of Bechtel National, Inc. (BNI) Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-003, Revision 0, 24590-WTP-ABCN-ESH-01-008, Revision 1, 24590-WTP-ABCN-ESH-02-011, Revision 0, 24590-WTP-ABCN-ESH-02-013, Revision 0," dated June 18, 2002.

4. **Categorization and Classification of Operational Emergencies** – Reportable incidents were categorized as soon as reasonably possible and in all cases within two hours of the event.

5. **Notification and Communications** – Timely notification and communications were provided to the emergency response organization, facility and co-located workers, offsite response agencies, and the public.

6. **Consequence Assessment** – Timely, continuous, and appropriate consequence assessments were provided.

7. **Protective Actions and Re-Entry** – Protective action guidance was provided for re-entry planning.

8. **Emergency Medical Support** – Emergency medical support was provided commensurate with the findings of the hazards assessment.

9. **Emergency Public Information** – Emergency public information was provided in the areas of facilities, equipment, personnel, and public education.

10. **Emergency Facilities and Equipment** – The control room or control area was designed to permit occupancy and actions to be taken to monitor the facility safely during normal operations and to provide safe control for anticipated accident conditions. The need for an alternate system that would allow the process to be placed in a safe state if the primary control area is uninhabitable was evaluated.

11. **Termination and Recovery** – Termination of operational emergencies, recovery, and resumption of normal operations was provided.

12. **Program Administration** – The Emergency preparedness program was described, including provision for periodic audits and assessments.

13. **Training and Drills** – The emergency preparedness training program was described, including provision for initial and annual refresher training for the emergency response organization, general employees, and response personnel from other agencies.

14. **Exercises** – Plans and resources were adequate to exercise, periodically, the Emergency Response Plan to ensure that protective measures could be implemented in the event of an accident.

3.15.2 Evaluation

In the area of emergency management, ORP had previously determined[83] that BNI's documents 24590-WTP-GPP-SIND-019, *Emergency Management Program*, and 24590-WTP-GPP-SIND-003, *Emergency Action Plan*, were acceptable to support limited construction. BNI had trained emergency response organization staff and implemented emergency response provisions sufficient to start construction. These two plans were also in effect for construction and will remain in effect until BNI's draft Emergency Response Plan is finalized before operations.

The reviewers evaluated PSAR Volume I, Section 15, and found it to be conditionally acceptable. The WTP, when operational, will be owned by DOE and operated by a contractor. Therefore, WTP emergency preparedness will be part of, and integrated with, Hanford emergency preparedness and the emergency preparedness document, DOE/RL-94-02. Section 15 of the PSAR was also found to be consistent with the draft Emergency Response Plan (see Section 5.3 of this SER).

The evaluation of the information for each of the 14 areas of an emergency management program is summarized below:

1. **Hazards Assessment** – The reviewers found the hazards assessment discussion to be acceptable, as found in PSAR Section 15.4.2.3. Table 15-1 included a matrix of accidents, accident types, consequences, and protective actions. The text noted, however, that a qualitative examination of a hazards survey will be prepared later to identify conditions that the management plan will address. This was acceptable to the reviewers because the plant's design is preliminary and BNI will not be able to provide a final hazard assessment until the design and construction are complete.

2. **Emergency Response Organization** – The reviewers found the discussion of the emergency response organization to be acceptable. PSAR Section 15.4.1 discussed the emergency response organization and described the responsibilities of key individuals, such as the building emergency director and the staff for the Incident Command Center, the event scene, the Hanford Emergency Response Operations Center, the Joint Information Center, the site management team, the executive team, security and event support, and the Unified Dose Assessment Center. Section 3 of the draft Emergency Response Plan also discussed the emergency response organization (see Section 5.3 of this SER).

3. **Offsite Response Interfaces** – The reviewers found the discussion of offsite response interfaces to be acceptable, as found in PSAR Section 15.4.1. Section 15.4.1 stated that when an emergency is declared, the Hanford Emergency Operations Center is activated to implement protective actions for site personnel and to recommend planned protective actions for the offsite public.

[83] 01-OSR-0391, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Phase A, Limited Readiness Inspection Report, IR-01-004," dated October 23, 2001.

Offsite response interfaces were also discussed in Section 10 of the draft Emergency Plan (see Section 5.3 of this SER), which stated that DOE had established a number of coordination agreements, or memoranda of understanding, with various agencies to ensure proper response availability. BNI will be a party in these DOE coordination agreements, which are described in DOE/RL-94-02, Section 3.0, Table 3-1.

4. **Categorization and Classification of Operational Emergencies** – The reviewers found the discussion of categorization of operational emergencies to be acceptable. PSAR Section 15.4.2 adequately described the process of categorizing and classifying events. However, it did not contain any facility-specific emergency action levels because the final hazard assessment had not yet been completed (nor is it required to be completed at this stage of construction). In response to Question LAW-PSAR-129 concerning the lack of emergency action levels, BNI clarified that these would be developed based on the outcome of the emergency preparedness hazard assessment. It also stated that specific emergency action levels will be developed into a DOE/RL emergency response procedure specific to the WTP. This was acceptable to the reviewers.

5. **Notification and Communications** – The reviewers found the notification and communications discussion to be acceptable. PSAR Section 15.4.3 stated that notifications will be made for events at the WTP according to DOE requirements to augment the Hanford Site and WTP operating staff with personnel in designated roles to respond to the emergency, to activate emergency centers, to facilitate public notification by offsite authorities and agencies with decision-making authority for directing protective actions, and to protect Hanford Site and WTP personnel and emergency workers by providing information necessary to implement accountability and protective actions such as take cover and sheltering.

   This commitment was implemented in Section 9.6 of the draft Emergency Response Plan (see Section 5.3 of this SER).

6. **Consequence Assessment** – The reviewers found the discussion of consequence assessment to be acceptable, as found in PSAR Section 15.4.2.3. Section 15.4.2.3 also noted that a hazard assessment will be conducted to determine if an event could result in the declaration of an operation emergency as described in DOE/RL-94-02. If the analysis indicated the potential for an Alert, Site Area Emergency, or General Emergency, the results of the analysis would be used to determine the necessary personnel, resources, and equipment for the emergency response. The WTP also will develop criteria for assessing the possible hazards to human health and the environment.

7. **Protective Actions and Re-Entry** – The reviewers found the discussion of protective actions and re-entry to be acceptable, as found in Section 15.4.5 (protective actions), Section 15.4.5.1 (protective action guides), Section 15.4.5.3 (WTP protective actions), and Section 15.4.7.2 (re-entry considerations).

   Section 7, "Incident Response" of the Emergency Response Plan also discussed implementation of protective actions and re-entry and stated that DOE/RL-94-02 provided a concept of operations for emergency response (see Section 5.3 of this SER).

8. **Emergency Medical Support** – The reviewers found the discussion of emergency medical support to be acceptable. PSAR Section 15.4.4 listed the Hanford site facilities that will be available for emergency medical support and noted they are described in DOE/RL-94-02. Section 15.4.4.1.4.1 discussed the WTP emergency medical facilities, and Section 15.4.4.1.4.2 stated that DOE and local hospitals had agreements in place for backup medical treatment, as discussed in DOE/RL-94-02. Through agreements with DOE, the WTP will use these existing agreements. BNI did not have to arrange for separate offsite medical care. The Hanford Fire Department will be used for onsite medical response through the site services contract mechanism that BNI has with Fluor-Hanford. The Hanford Fire Department's capabilities are documented in DOE/RL-94-02.

9. **Emergency Public Information** – The reviewers found the discussion of emergency public information to be acceptable. PSAR Section 15.4.1.3 discussed the Joint Information Center and the role BNI will play in staffing the center. The center's primary responsibility is to disseminate accurate, timely information to the public and employees about emergencies. It provides a single location where DOE/RL, ORP, and site contractors can coordinate the release of information following a site emergency. The center operates under the direction of DOE/RL's public information director and is managed and staffed by DOE/RL, ORP, and site contractor personnel. The center includes representatives from the states of Washington and Oregon, emergency planning zone counties, and other federal agencies.

10. **Emergency Facilities and Equipment** – The reviewers found the discussion of emergency facilities and equipment to be acceptable, as found in PSAR Sections 15.4.4.1 and 15.4.4.2, respectively. A list of emergency equipment will be developed and finalized in the Emergency Response Plan that must be complete before operations begin.

11. **Termination and Recovery** – The reviewers found the termination and recovery discussion to be acceptable. PSAR Section 15.4.7 described emergency termination, reentry, and recovery and stated that predetermined criteria for terminating emergencies will be developed and maintained in the WTP Emergency Plan implementing procedures and will be consistent with the Hanford Site emergency procedures. Reentry and recovery will include notifications associated with terminating an emergency and establishing criteria for resuming normal operations.

    Section 8, "Termination of Event, Incident Recovery, and Restart of Operations," of the draft Emergency Response Plan further described BNI's process for terminating an emergency (see Section 5.3 of this SER).

12. **Program Administration** – The reviewers found the program administration discussion to be conditionally acceptable. Neither the PSAR nor the implementing procedure discussed or described administering the emergency preparedness program. In response to Question LAW-PSAR-012 concerning program administration, BNI stated that PSAR Section 15.3 will be revised to reflect that DOE/RL-94-02, Section 14.0, "Program Administration," and its requirements will be contained as part of the Emergency Response Plan. As committed to in its response to Question LAW-PSAR-012, this will

be completed with the first PSAR revision following authorization for full facility construction.

In response to Question LAW-PSAR-129 concerning a failure to discuss program administration in the draft Emergency Response Plan, BNI clarified that the WTP will comply with the applicable portions of DOE/RL-94-02, Section 14.0. This will include providing WTP input to the Hanford Emergency Readiness Assurance Plan. BNI will also develop an internal assessment of the emergency preparedness activities program and will implement it before cold commissioning. A vital records program will be developed to ensure documents essential to the continued functioning of WTP are available during and after an emergency. These commitments will be incorporated into the first PSAR revision following authorization for full facility construction.

13. **Training and Drills** – The reviewers found the discussion of training and drills to be conditionally acceptable, as found in PSAR Section 15.4.6. Training and drills were not discussed or described in the draft Emergency Response Plan. In response to Question LAW-PSAR-129 concerning this absence, BNI clarified that training and drills will be conducted using DOE G-151.1, *Emergency Management Guide*, Volume V, Section 4.0, "Training and Drills," as a guide. The emergency manager will periodically assess the drill and training program, and the results will be used to improve the program. All identified deficiencies from drills will be compiled in a database and tracked until adequate corrective actions are implemented. Management will attend emergency response training to determine where enhancements can be made to ensure that proper training is provided. These commitments will be incorporated into the first PSAR revision following authorization for full facility construction.

14. **Exercises** – The reviewers found the discussion of exercises to be conditionally acceptable, as found in PSAR Section 15.4.6.2. BNI will establish a formal exercise program that will be documented in an implementing procedure, exercises will be critiqued, and corrective actions will be identified. In response to Question LAW-PSAR-129 concerning emergency exercises, BNI stated that it will conduct exercises according to the requirements of DOE/RL-94-02 and DOE/RL emergency procedures RLEP 3.10, "Developing Exercise Packages" (DOE-0223, *Emergency Plan Implementing Procedures*). These commitments will be incorporated into the first PSAR revision following authorization for full facility construction.

3.15.3 Conclusions

The reviewers concluded that the emergency preparedness section of the PSAR was conditionally acceptable. BNI adequately described the primary elements required in an emergency management program, which was verified to be generally consistent with the draft Emergency Response Plan. The reviewers concluded that BNI had committed to an acceptable emergency preparedness program.

Condition of Acceptance – Except for Item 2, BNI must complete the following action with the first PSAR revision following authorization for full facility construction:

1. Revise PSAR Section 15.3 to reflect that DOE/RL-94-02, *Hanford Emergency Management Plan*, Section 14.0, "Program Administration," and its requirements will be contained as part of the Emergency Response Plan, as committed to in response to Question LAW-PSAR-012. (See Section 3.15.2, Item 12.)

2. Revise PSAR Section 15 to reflect that, for WTP Emergency Response Plan program administration, BNI will provide WTP input to the Hanford Emergency Readiness Assurance Plan. Develop an internal assessment of the emergency preparedness activities program and implement it before cold commissioning, and develop a vital records program to ensure documents essential to the continued functioning of WTP are available during and after an emergency. This was committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 12.)

3. Revise PSAR Section 15.4.6 to clarify that training and drills will be conducted using DOE G-151.1, *Emergency Management Guide*, Volume V, Section 4.0, "Training and Drills," as a guide. Clarify that the emergency manager will periodically assess the drill and training program, and the results will be used to improve the program. Clarify that all identified deficiencies from drills will be compiled in a database and tracked until adequate corrective actions are implemented. Clarify that management will attend emergency response training to determine where enhancements can be made to ensure that proper training is provided. This was committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 13.)

4. Revise PSAR Section 15.4.6.2 to reflect that exercises will be conducted in accordance with DOE/RL-94-02, *Hanford Emergency Management Plan*, and DOE/RL emergency procedures RLEP 3.10, "Developing Exercise Packages" (DOE-0223, *Emergency Plan Implementing Procedures*), as committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 14.)

3.16 Deactivation and Decommissioning

The purpose of this review was to determine whether the PSAR adequately described the design features for early and partial construction that will enhance facility decommissioning and help reduce radiation exposure of site personnel and the public. The review also examined the plans for preparing and retaining records important to deactivation and decommissioning (D&D). This review was specific to the PSAR, Volume I, *General Information*, as it related to D&D.

3.16.1 Requirements

DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," Item 9, and Table S7-1 of the BNI Contract contain the requirements for D&D. Acceptance criteria were discussed in RL/REG-99-05, Section 11.0, "Deactivation and Decommissioning." The submittal on D&D was acceptable if the following criteria were met:

1. Design provisions were incorporated to facilitate deactivation and final decommissioning. These design provisions reduce radiation exposure to Hanford Site personnel and the public during and following D&D activities and minimize the quantity of radioactive waste generated during deactivation.

2. A draft deactivation plan provided details on how the facilities will be deactivated following completion of waste processing.

3. Plans were described for minimizing contamination. Guidance for minimizing contamination is provided in NUREG-1520, Section 10, "Deactivation and Decommissioning."

In addition, BNI Contract specification C.7 (12) requires functional design requirements that included process and facility design features to safely and efficiently facilitate deactivation, decontamination, decommissioning, and closure of the facilities according to RCRA.

SRD Safety Criterion 8.0-2 states in part that, "Features and procedures that simplify and facilitate decommissioning … shall be identified during the planning and design phase based upon a proposed decommissioning method…."

3.16.2 Evaluation

The reviewers evaluated how construction of the LAW, HLW, and PT facilities will impact safe and efficient deactivation, decontamination, and decommissioning. Two criteria were conditionally met and one was evaluated in another section of this SER. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the description of D&D planning and recordkeeping to be conditionally acceptable. PSAR Section 16.3.2 stated that sampling will be required to support D&D activities. Chapter 16 listed DOE O 430.1A, *Life Cycle Asset Management*, as a requirement. DOE O 430.1A, Section 6.G. (6)(a)(I), states, in part, that the disposition process should provide for the site characterization and be updated as necessary to reflect changes in facility conditions throughout the process.

   In response to Question LAW-PCAR-029 concerning plans to assess pre-existing hazardous and radioactive conditions at the construction site, BNI described its radiological survey program during partial construction and stated that the Contract does not require installed design features to characterize the soils under the site buildings during or after operations. Instead, the facility relies on design features to contain contamination and prevent the release of dangerous waste to the soil, groundwater, surface water, or air. Clean closure of the soil beneath the WTP will be accomplished by maintaining facility integrity and therefore preventing contaminants from reaching the soil. While this approach to ensuring a safe and efficient D&D was acceptable, sampling will be required to characterize the site following operation and transition to D&D.

Chapter 16 of the PSAR presented many design actions, such as the selection of architectural materials, processes, and SSCs that will reduce occupational and public exposure during D&D. However, it did not specifically state the objective of reducing dose as required in SRD Safety Criteria 8.0-1 and 8.0-2. In response to Question LAW-PCAR-028 concerning radiation doses during D&D, BNI committed to make clear its commitment to reduce radiation exposure to the workers and the public during and following D&D activities. BNI stated that the PSAR will be revised to reflect this commitment with the first PSAR revision following authorization for full facility construction. This commitment was acceptable.

In Section 16.3.5, the PSAR committed that the facility will be designed to ensure that high-level radioactive waste, transuranic waste, mixed waste, hazardous waste, and low-level waste are identified, minimized, and disposed of to support the D&D process. This commitment was acceptable.

In Chapter 16, the PSAR committed to ensure the authorization basis documentation will be maintained to facilitate D&D. Deactivation endpoints will be established and the closeout documentation will include records of the verification methods. Transition readiness reviews will be performed, documented, and turned over to DOE consistent with DOE G-430.1-5, *Transition Implementation Guide*. Records of the LAW, HLW, and PT facilities would fall in this category and be maintained pursuant to the QAM. This commitment was acceptable.

In Questions LAW-PSAR-197 and -198, the reviewers asked how SRD Safety Criterion 8.0-2 would be addressed for the C5 ventilation exhaust piping embedded in the HLW basemat. BNI responded to LAW-PSAR-197 by proposing to add the following statement to Section 16.3.5 with the first PSAR revision following authorization for full facility construction: "While the proposed decommissioning method has not been specified, the facility is being designed to limit contamination, facilitate decontamination, and minimize the dose and generation of waste in the event re-use or demolition of the facility is the ultimate decommissioning method." Because DOE has not yet stipulated the ultimate decommissioning method, the reviewers found that BNI's response to LAW-PSAR-197 was acceptable (to address options that could result in the greatest post operational dose and generation of waste). The reviewers found this commitment acceptable.

In response to LAW-PSAR-198, BNI stated that the *Operations Requirement Document* (24590-WTP-RPT-OP-01-001) and the *Basis of Design* (24590-WTP-DB-ENG-01-001) require coaxial piping, secondary containment, leak detection, etc., to be used to minimize the impact of spills and the ability of piping and equipment to be decontaminated. This indicates that the design of pipe or ducting containing radioactive or dangerous fluids under normal use and anticipated accidents will include provisions to minimize the impact of spills and the ability to be decontaminated to facilitate reuse or demolition of the WTP. BNI also explained how the embedded HLW C5 ventilation piping met the design criteria and concluded that the design will limit contamination, facilitate decontamination, and minimize both dose and the generation of waste in the

event of re-use or demolition of the facility. The reviewers found that the BNI response to LAW-PSAR-198 was acceptable.

2. The draft Deactivation Plan was submitted with the CAR, and its review is addressed in Section 5.8 of this SER.

3. The reviewers found the description of plans for minimizing contamination to be conditionally acceptable. The PSAR described engineering methods and procedures to limit and control contamination, including design methods, process, and administrative controls. Section 16.3.1 incorrectly referred to R1, R2, and R3 as contamination classifications. In response to Question LAW-PCAR-030, BNI said that they would revise the section to use notations consistent with current practices.[84] The reviewers found the commitment in response to Question LAW-PCAR-030 to be acceptable.

3.16.3 Conclusions

The reviewers concluded that the D&D commitments were conditionally acceptable. The PSAR adequately described how D&D principles were factored into the facility design and construction. The reviewers concluded that BNI had committed to design features that will facilitate decommissioning of the facilities and maintaining the documents necessary to facilitate decontamination.

Conditions of Acceptance – BNI must complete the following changes to Chapter 16 of Volume I of PSAR with the first PSAR revision following authorization for full facility construction.

1. In Chapter 16 of the PSAR, clarify its commitment to reduce radiation exposure to workers and the public during and following D&D, as committed to in response to Question LAW-PCAR-028. (See Section 3.16.2, Item 1.)

2. Add the following statement to Section 16.3.5: "While the proposed decommissioning method has not been specified, the facility is being designed to limit contamination, facilitate decontamination, and minimize the dose and generation of waste in the event re-use or demolition of the facility is the ultimate decommissioning method," as committed to in response to Question LAW-PSAR-197. (See Section 3.16.2, Item 1.)

3. Change the R1, R2, and R3 contamination classifications listed in Section 16.3.1 to be consistent with current practices, as committed to in response to Question LAW-PCAR-030. (See Section 3.16.2, Item 3.)

[84] 24590-WTP-GPP-SRAD-007, *Classification of Areas*, and RPT-W375LV-NS00001, *Classification of Areas Report for LAW.*

3.17 Management, Organization, and Institutional Safety Provisions

The purpose of this review was to determine whether the PSAR adequately described management systems and structures and the qualifications for key management positions. The review also assessed whether the PSAR had described provisions for planning, implementing, and controlling site activities in a manner that protects the safety of the facility and co-located workers, the public, and the environment. Other elements in this review were the configuration management, audits and assessments, incident reporting and investigations, and records management programs. This review was specific to the PSAR, Volume I, *General Information*, as it related to management, organization, and institutional safety provisions.

3.17.1 Requirements

The requirements for organization and administration, configuration management, audits and assessments, incident reporting and investigations, and records management programs are identified separately below.

Organization and Administration – DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," Item 1, contains the requirements for organization and administration. RL/REG-99-05, Section 2.0, "Organization and Administration," contains criteria for acceptance. The submittal was acceptable if the following criteria were met:

1. Corporate and Contractor policies contained a strong commitment to safety and protection of worker health and the environment.

2. The responsibilities of the specific organizations and organizational groups responsible for performing ITS activities during the facility design and construction phases were described. Organizational charts were included.

3. Clear management controls and communications among the organizational units responsible for designing and constructing the facility were provided.

4. Substantive breadth, level of experience, and availability of personnel to complete the facility's design, construction, and preoperational testing were demonstrated. Position descriptions clearly defined the qualifications, responsibilities, and authorities for key supervisory and management positions responsible for health, safety, and the environment. The descriptions will be accessible to affected personnel and to reviewers upon request. The submittal described how the organization (e.g., management and supervisory positions) will be structured to perform ITS activities as the facility transitions from design to construction and from construction to operation.

5. In the organizational hierarchy, the ES&H oversight organization(s) were shown to be independent of the operational organizations, allowing them to provide objective audit, review, or control activities. (As used here, "independent" means that neither

organization reports to the other administratively; however, both may report to a common manager.) Lines of responsibility and authority were clearly drawn.

6. The activities essential for effectively implementing the ES&H programs were documented in formally approved written procedures that comply with a formal document control program.

7. A simple mechanism was available for all employees for reporting potentially unsafe conditions or activities to the ES&H organization and/or to upper management.

8. Effective lines of communication and authority were clearly defined and exercised among the organizational units involved in the facility's engineering and ES&H functions.

9. Formal management control systems were identified to ensure the availability and reliability of ITS SSCs.

10. Arrangements were in place for providing emergency resources such as fire, police, ambulance/rescue units, and medical services.

Configuration Management – Chapter 4.0, "Engineering and Design," and Chapter 7.0, "Management and Operation," of the SRD contain the requirements for configuration management (CM). Section 3.1, "Configuration Management," of RL/REG-99-05 contains acceptance criteria for CM. The submittal was acceptable if the following criteria were met:

1. The overall CM program, which may be applied in a graded approach, described at least the following:

   (a) The scope of the ITS SSCs to be included in the CM program
   (b) Each CM program activity and its objectives
   (c) Each CM program activity's organizational responsibilities and staffing interfaces.

2. Design requirements and associated design bases were demonstrated to be established and maintained by an appropriate organizational unit. The CM program, supported by the project schedule logic, ensured that design activities do not start until appropriate design criteria are established. The design criteria and bases for those ITS SSCs were identified.[85]

3. An acceptable method was described whereby documents are specified, prepared, reviewed, approved, stored, and maintained according to approved procedures and instructions. Measures were established to ensure that documents are legible, identifiable, retrievable, and protected against damage, deterioration, or loss.[86] A process was described for ensuring that current documentation, including revisions, is distributed

[85] ISMP, Section 8.0, "Document Control and Maintenance."
[86] ISAR, Section 3.8, "Records Management."

and used to perform work activities.[87] The types of documents controlled were listed and included essential documents, such as drawings, procurement specifications, engineering analyses, and training/qualification records.[88]

4. The review of authorization basis changes before they are implemented was described to ensure that the impact on safety was analyzed and acceptable. An acceptable change control process was described to ensure that changes to the authorization basis are systematically reviewed. The process was consistent with RL/REG-97-13, *Regulatory Unit Position on Contractor-Initiated Changes to the Authorization Basis.*

5. The Contractor submits a draft USQ Plan that meets the requirements of SRD Safety Criteria 7-4.1 through 7-4.5 and includes, but it not limited to, the following:

   (a) A description of how temporary or permanent changes in the facility from the existing authorization basis will be assessed

   (b) A description of how temporary or permanent changes in procedures as derived from existing authorization basis will be assessed

   (c) A description of how tests and experiments not described in the existing authorization basis will be assessed

   (d) A description of procedures that will be developed to implement the USQ Plan.

Audits and Assessments – Subpart A of 10 CFR 830 contains the requirements for audits and assessments. RL/REG-99-05, Section 3.6, "Audits and Assessments," contains criteria for acceptance of audits and assessment. The submittal was acceptable if it committed to objectively evaluate the effectiveness and implementation of ITS activities and if the following criteria were met:

1. The frequency and scope for audits and assessments, including reviews of activities pertinent to safety and environmental protection, were described.

2. The qualifications and responsibilities of the manager responsible for the audit and assessment activity were identified.

3. The group performing independent assessments was given sufficient authority and freedom from the line organization to carry out their responsibilities.

4. A process was described for management to assess its management processes.

5. Audits and assessments were demonstrated to be conducted according to written procedures and checklists. Deficiencies noted during audits and assessments were communicated to appropriate management for prompt resolution.

[87] QAM, Policy Q-06.1.
[88] ISMP, Chapter 8.0, "Document Control and Maintenance."

6. Findings and recommendations and their distribution to appropriate management for review and response were documented. A corrective action program was described for ensuring that corrective actions were properly controlled.

7. For areas pertinent to facility construction, BNI was prepared to implement the audits and assessments program when initiating construction.

Incident Reporting and Investigations – DOE/RL-96-0003, Section 3.3.5, "Oversight Process Determination," and Table S7-1 of the BNI Contract establish the oversight process requirements. RL/REG-99-05, Section 3.7, "Incident Report and Investigations," contains acceptance criteria for incident reporting and investigations. The submittal was acceptable if the following criteria were met:

1. A suitable standard for incident reporting and investigation for construction was provided.

2. A program was described and included a Construction Occurrence Reporting Plan that was consistent with the incident reporting and investigation standard.

3. A draft Occurrence Reporting Plan and a draft Plan for Operational Assessment Reports were provided.

Records Management – SRD Safety Criterion 4.0-3 and Subpart A of 10 CFR 830 contain the requirements for records management. RL/REG-99-05, Section 3.8, "Records Management," contains acceptance criteria for records management. The records management submittal was acceptable if it committed to a records management system that described quality requirements for ITS SSCs records and if the following criteria were met:

1. As stipulated in Subpart A of 10 CFR 830, ITS records were specified, prepared, reviewed, approved, and maintained.

2. ITS records were legible, identifiable, and retrievable for their designated lifetimes.

3. ITS records associated with ITS SSCs were protected against tampering, theft, loss, unauthorized access, damage, or deterioration while they are in storage.
4. Procedures were established and documented, specifying the requirements and responsibilities for selecting, verifying, protecting, transmitting, distributing, retaining, maintaining, and disposing of QA records.

5. The organization and procedures were in place to promptly detect and correct any deficiencies in managing records or implementing ITS records.

3.17.2 Evaluation

The individual areas reviewed were evaluated separately and are summarized below.

Organization and Administration – The reviewers evaluated the organization and administration description and found it to be acceptable. BNI's response to Question LAW-PCAR-038 concerning its corporate policy on safety demonstrated a strong corporate commitment to safety and protection of worker health and the environment. The overall management structure and organization, referenced as Figure 1 in the QAM, Policy Q-01.1, was appropriate for design and construction. The ES&H oversight organization was independent of the other parts of the operation, ensuring that ES&H priorities were not sacrificed to another line mission or objective. Based on review of the submittal, Attachment 8, "Contractor's Technical and Experience Qualifications to Construct the Plant," the key supervisory and management personnel were judged to have substantive breadth and level of experience.

Configuration Management – The reviewers evaluated the description of the CM program in PSAR Section 17.4.3 and as referenced in the ISMP, Section 1.3.16, "Configuration Management." Of the five criteria, three were acceptably met and two were conditionally met. SRD Safety Criterion 4.0-1 committed to use ISO 10007, *Quality Management – Guidelines for Configuration Management*, as the standard for developing and implementing the CM program for the WTP. The description of the CM program was consistent with this standard. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the CM program description to be conditionally acceptable. The evaluation for each subelement of that description is summarized below:

   (a) The reviewers found the description of the CM program scope to be acceptable. The PSAR stated that the CM program will provide direction for identifying and documenting the physical and functional characteristics of facility SSCs and computer software. Section 1.3.16, "Configuration Management," of the ISMP described the CM approach, which included identifying and documenting configured items. Selection of configured items considered the functional and physical characteristics that can best be managed to achieve the overall WTP project performance objectives related to radiological, nuclear, and process safety. In this regard, the ISMP identified items for CM that included SSCs, plant installed software, project interfaces, and authorization basis documents.

   (b) The reviewers found the description of the CM program activities and objectives to be acceptable. Section 1.3.16 of the ISMP described the four-step CM approach that would be used: (1) identification and documentation, (2) change control, (3) status tracking and reporting, and (4) configuration audit. Each step and its objectives were described in detail.

   (c) The reviewers found the description of the CM program's organizational responsibilities and staffing interfaces to be conditionally acceptable. Neither the PSAR nor the ISMP contained details of the program's organizational responsibilities and staffing interfaces. Similar issues were identified during the CM inspection in May 2002. Corrective actions were identified in the inspection and will be tracked to completion. In response to Question LAW-PCAR-005 concerning staffing interfaces, BNI committed to add to PSAR Volume I, Section 17.4.3 specific information that described the CM program's

organizational responsibilities and staffing interfaces in the first PSAR revision following authorization for full facility construction. This commitment was acceptable to the reviewers.

(d) The reviewers found the description of essential elements used to maintain design configuration to be acceptable. Section 1.3.16.3, "Change Control," of the ISMP committed to a formal, proceduralized CM process for controlling design configuration. The process included documentation, engineering evaluation, approval, and implementation controls.

2. The reviewers found the description of design requirements in the PSAR to be acceptable. The PSAR committed to compiling Contract, basis of design, functional specification, operational requirements document, and authorization basis design requirements in a Microsoft Access® database – the Design Criteria Database. The CM organization is responsible for maintaining the database to integrate design requirements, safety standards, and operational requirements. The PSAR also committed to not initiate design activities until appropriate design criteria are established.

3. The reviewers found the description of document control to be acceptable. The PSAR committed to establishing document control procedures that prescribe the process for preparing, reviewing, approving, storing, and maintaining specified project documents in either hard copy or electronic media, as well as ensuring that current and technically accurate documents are available to and used by individuals performing work at the work locations. The PSAR referenced Table 8-1, "Safety Management Records," of the ISMP for specifying project documents that are subject to document control; the documents in this table include those essential to ensuring that quality and safety are maintained. In addition, the PSAR committed to complying with QAM Policies Q-05.1, Q-06.1, and Q-17.1 for developing and controlling documents and for maintaining associated quality records.

4. The reviewers found the description of change control to be acceptable. The PSAR described and committed to a change control process under its CM program that includes the required elements of documentation, evaluation, approval, and implementation. The CM program will ensure that a change and the reasons for it are described and documented, the impact on related documents is identified with necessary changes considered, approval of changes is commensurate with the process applied to the original configuration, and changes are implemented and controlled through formal processes and procedures.

5. The reviewers found the draft USQ Plan conditionally acceptable, as found in PSAR Volume I, Section 17.4.6. The reviewer evaluated this PSAR section against the requirements of SRD Safety Criteria 7.4-1 through 7.4-5. Section 17.4.6 described BNI's draft USQ Plan.

   The PSAR description of changes to the WTP facility that require consideration and evaluation for possible USQs was consistent with the requirements of the SRD, as was the definition of what constitutes a USQ. Several sections provided details of the types of

changes that were within the scope of the USQ evaluation process: Sections 17.4.6.1 on temporary or permanent changes to the WTP as described in the safety basis, 17.4.6.2 on temporary or permanent changes to WTP procedures, 17.4.6.3 on WTP tests or experiments not described in the existing safety basis, and 17.4.6.4 on changes to a system or component as described in the safety basis. The PSAR was conservative in describing the scope of changes requiring application of the USQ process in that both explicit and implicit changes were required to be considered. In addition, not only the change, but also the process of implementing the change, must be evaluated for the possibility of being a USQ. The reviewers found this to be consistent with SRD Safety Criterion 7.4-1 with the following exceptions:

(a) Section 17.4.6 of the PSAR stated that the USQ process will be implemented after the project authorization basis documents for operation are approved and implemented. Question LAW-PSAR-161 was asked to clarify the timing of USQ process implementation, given that systems and facilities will be operated with chemicals and simulants during cold commissioning, and with active waste during hot commissioning in advance of authorization for operations. In response, BNI committed to revise the first paragraph in Section 17.4.6 to read, "The USQ process will be established during implementation of the approved FSAR, which will precede start of the hot commissioning portion of the operations phase. The USQ process will allow project management to make changes to the facility, the procedures, and the Authorization Basis document; …" In response, BNI also committed to establishing a "USQ-like" process before the start of cold commissioning and to describing this process in a PSAR supplement on a schedule providing for adequate review by DOE. This was acceptable to the reviewers.

(b) PSAR Section 17.4.6 stated that, "The existence of a nonconforming and degraded condition does not automatically require a USQ evaluation. However, a USQ evaluation is required if the condition or the implementation of the resolution for the condition is a change to the facility that potentially creates a USQ." Question LAW-PSAR-160 was asked to clarify the application of the USQ process to degraded and nonconforming conditions, including a discussion of the factors that BNI would consider in determining whether a USQ evaluation was required. In response, BNI committed to revise the last sentence of paragraph two in Section 17.4.6 to read, "However, a USQ evaluation is required for a nonconforming or degraded condition if the resolution of the condition is to 'use as is' or 'repair.' A USQ evaluation would also be required for an interim compensatory action that is proposed to deal with the degraded or nonconforming condition as part of the disposition process." This was acceptable to the reviewers.

The PSAR committed to written USQ determinations for potential inadequacies in the existing safety analyses that support the DOE-approved safety basis, as well as for conditions in which the margin of safety is reduced. Sections 17.4.6.5 and 17.4.6.6 described these conditions and the actions necessary when they are discovered. Actions required included (1) placing or maintaining the facility in a safe condition, (2) notifying

DOE in a timely manner, (3) performing and submitting the results of a USQ determination, and (4) completing an evaluation of the condition and submitting it to DOE before removing any operational restrictions to compensate for the discrepancy. The reviewers found this to be consistent with the requirements of SRD Safety Criterion 7.4-4 and acceptable.

The PSAR committed to developing a procedure for the USQ process that included the program elements described in Section 17.4.6. In addition, the PSAR committed to develop training and qualification requirements for USQ evaluators and to maintaining the list of qualified evaluators. For the USQ process and its implementation, the PSAR also described organizational responsibilities and authorities that were acceptable to the reviewers, including (1) developing the USQ procedure, the training and qualification requirements for USQ evaluators, and maintenance of the list of qualified evaluators by the ES&H organization; (2) approving the USQ procedure and establishment of training and qualification requirements for USQ evaluators by the ES&H Manager, (3) supporting project functional organizations in establishing procedures requiring performance of USQ evaluations when conditions for doing so are met by the CM organization, and (4) approving positive USQ determinations before the Project Safety Committee submits them to DOE. The reviewers found this consistent with SRD Safety Criteria 7.4-2 and 7.4-3 and acceptable.

The PSAR committed to documenting USQ evaluations, including the bases for the determinations, and maintaining them as records. In addition, changes to authorization basis documents would be incorporated based on the USQ evaluation results and submitted to DOE on a schedule corresponding to the updates of the authorization basis documents. The PSAR will include a report summarizing all situations for which a safety evaluation was required and indicating all "changes" considered in a safety evaluation and implemented three months or more before the submittal date of the authorization basis documents. The reviewers found this consistent with SRD Safety Criterion 7.4-5 and acceptable.

Audits and Assessments – The reviewers found the PSAR description of the audits and assessments program and all seven review criteria to be acceptable. The reviewers evaluated PSAR Section 17.4.2, which addressed management and independent audits and assessments and referred to the QAM, Policies Q-18.1 and Q-18.3. The reviewers evaluated these two policies for each item in the review guidance and found each item to be adequately addressed. Subsection 17.4.2 did not address the procedures for ensuring that identified deficiencies were corrected in a timely and effective manner. However, this was addressed under QAM Policy Q-16.1, which is part of the authorization basis previously approved by ORP. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the description of the frequency and scope of independent audits and assessments, including schedules in Sections 3.2 and 3.3 of QAM Policy Q-18.1, to be acceptable. QAM Policies Q-18.1, Q-18.2, and Q-16.1, described, respectively, guidance for conducting the audits and surveillances, assignment of responsibilities for each phase of the work, procedures for recording the results of the audits and assessment activities, and assurance that identified deficiencies were corrected in a timely and

effective manner. QAM Policy Q-18.3 identified the frequency and scope for management audits and assessments, guidance for conducting the audits, and assignment of responsibilities.

In response to Question LAW-PCAR-034 concerning the procedures for recording the results of management assessments, BNI stated that the requirement to record the results of management assessments and the scope of management assessment reports was addressed in 24590-WTP-GPP-MGT-002, *Management Assessments*. This was acceptable to the reviewers.

2. The reviewers found acceptable the identification of the qualifications and responsibilities of the manager responsible for the independent audit and assessment activity in QAM Policy Q-18.1 and of the managers responsible for the management assessment activity in QAM Policy Q-18.3. In response to Question LAW-PCAR-034 concerning documentation of qualifications for the audit manager and personnel responsible for audit and assessment activities, BNI stated that qualifications of all BNI personnel were established and documented in position descriptions and were verified when the individuals were hired. QAM Policy Q-02.3 contains qualification requirements for independent audit and assessment personnel. BNI also noted that management assessments were considered a normal job activity and that a management assessment procedure defined how to conduct the assessments. This was acceptable to the reviewers.

3. The reviewers found acceptable the description of the provision for sufficient authority and freedom from the line organization for the group performing independent assessments, as described in Section 3.5 of QAM Policy Q-18.1.

4. The reviewers found the description of management assessments of management processes, described in QAM Policy Q-18.3, to be acceptable.

5. The reviewers found the commitment to conduct audits and assessments according to written procedures and checklists, as described in Sections 3.4.2 and 3.7.2 of QAM Policy Q-18.1, to be acceptable. The policy committed to communicating deficiencies noted during audits and assessments to appropriate management for prompt resolution.

6. The reviewers found acceptable the description of the process for documenting findings and recommendations and distributing them to appropriate management for review and response, as described in QAM Policy Q-18.1.

7. The reviewers found acceptable the description of the following safety areas and management control systems to be addressed in audits and assessments: radiological controls, NCS (as appropriate), chemical process safety, fire safety, emergency management, environmental protection, QA, CM, maintenance, training and qualification, procedures, human factors, incident investigation, and records management.

Incident Reporting and Investigations – The reviewers found the PSAR description of incident reporting and investigation to be conditionally acceptable. The reviewers found one of the three criteria to be acceptably met, one to be conditionally met, and one addressed in a separate section of this SER. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the commitment to a suitable standard for incident reporting and investigations for construction to be acceptable. The PSAR referenced SRD Safety Criteria 7.7-1 through 7.7-8 and Sections 1.3.17, 3.16.3, and 5.6.7 of the ISMP as the appropriate standards for incident reporting and investigations.

2. The reviewers found conditionally acceptable the commitment, in Section 17.4.7, that the construction occurrence reporting would be done according to DOE O 232.1A, *Occurrence Reporting and Processing of Operations Information*; its associated DOE Manual 232.1-1A; and BNI procedure 24590-WTP-GPP-SIND-001-0, *Reporting Occurrences in Accordance with DOE Order 232.1A*.

   Question LAW-PCAR-037 asked whether the referenced BNI procedure, 24590-WTP-GPP-SIND-001-0, could be used for partial construction activities because the procedure's scope stated it was relevant to activities and hazards that could be encountered during the project's design and limited construction phase. BNI responded that although the scope of the procedure was only for limited construction, the procedure had been developed to address hazards and activities that would be expected to occur during the project's full construction phase. BNI re-evaluated the procedure for hazards and activities that would be associated with work performed during the project's partial construction phase and determined that work activities and hazards experienced then would be less severe than hazards associated with the full construction phase. Therefore, the procedure was applicable during partial construction. However, in the question response, BNI stated that the procedure would be revised to address hazards and activities for the cold commissioning phase before the start of preoperational testing. This commitment was acceptable to the reviewers.

   Question LAW-PCAR-032 concerned excluding SRD Safety Criterion 7.7-9 from occurrence reporting requirements. Criterion 7.7-9 required BNI to ensure that subcontractors and suppliers report defective items, materials, and services and that BNI must specify the requirements in applicable documents. BNI responded that Safety Criterion 7.7-9 was implemented by the QAM. The reviewers verified this and found the response to be acceptable.

3. The draft Occurrence Reporting Plan (for operations and hot commissioning) and draft Plan for Operational Assessment Reports were submitted with the PSAR and are addressed in Sections 5.1 and 5.11, respectively, of this SER.

Records Management – The reviewers found the PSAR description of records management and all five review criteria to be acceptable. For this area, the reviewers evaluated PSAR Section 17.4.4, which referred to the QAM, Policies Q-05.1 and Q-06.1, to describe the project document control system and to Policy Q-17.1 for controlling records to ensure they are legible, identifiable, retrievable, and protected against damage, deterioration, or loss. PSAR

Section 17.4.4 did not address the procedures to promptly detect and correct any deficiencies in managing records or implementing QA records. However, this aspect is covered in QAM Policy Q-16.1, which was previously approved by ORP and part of the authorization basis. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found the identification, preparation, and maintenance of ITS records to be acceptable, as discussed in Section 3.1.2 of the QAM, Policy Q-17.1. The PSAR described the review and approval of records in Section 3.7 of Policy Q-06.1.

2. The reviewers found the description of the requirement that QA records are to be legible and identifiable to be acceptable, as found in the QAM, Policy Q-17.1, Section 3.2.1. The records' retrievability over their designated lifetimes was adequately described in the QAM, Policy Q-17.1, Section 3.6.7. In addition, for computer codes or computerized data for ITS items, the PSAR, by reference to the QAM, Policy Q-17.1, Section 2, adequately described procedure(s) for maintaining readability and usability of older codes/data as computing technology changes.
3. The reviewers found acceptable the description of measures to protect against tampering, theft, loss, unauthorized access, damage, or deterioration of records for the time they are in storage, as described in Sections 3.5.3, 3.6.2, and 3.6.3 of the QAM, Policy Q-17.1.

4. The reviewers found acceptable the commitment in the QAM, Policy Q-17.1, to establish and document procedures specifying the requirements and responsibilities for selecting, verifying, protecting, transmitting, distributing, retaining, maintaining, and disposing of QA records.

5. The reviewers found acceptable the description in the QAM, Policy Q-16.1, of the organization and procedures in place to promptly detect and correct any deficiencies in managing records or implementing QA records. While this policy was not referenced in the submittal, the QAM is part of the authorization basis and was previously approved by ORP.

3.17.3 Conclusions

The reviewers concluded that the description and commitment to audits and assessments, incident report and investigations, and records management were acceptable as presented in PSAR Volume I, Section 17. The reviewers also concluded that the organization and administration and the CM descriptions and commitments were acceptable if BNI committed to complete the following changes:

Conditions of Acceptance – BNI must complete the following actions. Except for Item 4, the actions should be completed with the first PSAR revision following authorization for full facility construction:

1. Describe organizational responsibilities and staffing interfaces for the CM program in PSAR Volume I, Section 17.4, as committed to in response to Question LAW-PCAR-005. (See Section 3.17.2, Configuration Management, Item 1[c].)

2. Revise the first paragraph in PSAR Volume I, Section 17.4.6, to read, "The USQ process will be established during implementation of the approved FSAR, which will precede start of the hot commissioning portion of the operations phase. The USQ process will allow project management to make changes to the facility, the procedures, and the Authorization Basis documents; …" In addition, establish a "USQ-like" process before the start of cold commissioning, and describe this process in a PSAR supplement on a schedule providing for adequate review by DOE, as committed to in response to Question LAW-PSAR-161. (See Section 3.17.2, Configuration Management, Item 5[a].)

3. Revise the last sentence of paragraph two in PSAR Volume I, Section 17.4.6, to read, "However, a USQ evaluation is required for a nonconforming or degraded condition if the resolution of the condition is to 'use as is' or 'repair.' A USQ evaluation would also be required for an interim compensatory action that is proposed to deal with the degraded or nonconforming condition as part of the disposition process," as committed to in response to Question LAW-PSAR-160. (See Section 3.17.2, Configuration Management, Item 5[b].)

4. Revise procedure 24590-WTP-GPP-SIND-001-0, *Reporting Occurrences in Accordance with DOE Order 232.1A*, to address hazards and activities for the cold commissioning phase before the start of the preoperational testing phase, as committed to in response to Question LAW-PCAR-037. (See Section 3.17.2, Incident Reporting and Investigation, Item 2.)

3.18 Fire Protection

The purpose of this review was to determine if BNI had acceptably implemented those elements of a comprehensive fire safety program applicable to the full construction of the LAW, HLW, and PT buildings and selected portions of the BOF systems and structures.

3.18.1 Requirements

DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," contains the requirements for a fire protection program and states that the Contractors design must comply with the design-related part of the SRD. The SRD, Section 4.5, "Fire Protection," provides related requirements. In the SRD, BNI selected DOE's fire safety criteria[89] and applicable codes and standards promulgated by the National Fire Protection Association (NFPA)[90] for designing and constructing the waste treatment facilities. Following the guidance in RL/REG-99-05, Section 8.0, "Fire Safety," the submittals on fire protection were acceptable if they met the following criteria:

[89] DOE O 420.1A and DOE-STD-1066-97, *Fire Protection Design Criteria*.
[90] NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials," and applicable NFPA standards invoked therein.

1. The documented fire protection program is comprehensive, including adequate incorporation of fire safety and emergency services policies, programs, practices, and procedures as well as the adoption of DOE and NFPA codes and standards as delineated in the SRD. Specific fire safety roles and responsibilities are clearly delineated. Sufficient staffing is provided by qualified fire safety professionals with sufficient knowledge and experience in relevant elements of fire protection engineering and emergency services. Fire protection requirements are documented and incorporated in plans, specifications, procedures, and acceptance tests that are reviewed by qualified fire protection engineers.

2. Qualifications and experience are specified for positions involved in fire protection functions and activities that affect WTP fire safety. Project personnel are trained to recognize fire hazards and have a working knowledge of the WTP fire protection and fire prevention programs.

3. A WTP fire prevention program is in place and includes provisions to control the handling and storage of combustible materials, ignition sources, and degradations to fire protection features. The program includes provisions to establish, implement, and maintain a fire safety issues management system to identify and track to completion fire safety program issues, such as assessment findings. Agreements are in place to ensure appropriate emergency response services, including both personnel and equipment, to respond to WTP site emergencies.

4. Structures containing ITS systems or components are designed according to construction classifications identified in the Uniform Building Code (UBC), 1997 Edition. Included are structural building components such as walls, floors, roofs, columns, and beams, as well as interior building features. The process design separates and isolates operations that present fire hazards by distancing and/or compartmentalizing operations using fire barriers.

5. The facility fire hazard analyses are comprehensive; accurately characterize the hazards from fire, chemical explosions, and related events; adequately identify the means necessary to sufficiently mitigate these hazards; and reflect facility conditions consistent with the scope of the construction authorization.

3.18.2 Evaluation

The reviewers evaluated PSAR Volume I, Section 18; the Preliminary Fire Hazard Analyses (PFHA)[91] for the LAW, HLW, PT and BOF buildings; and 24590-WTP-PL-ESH-02-004, *WTP Fire Protection Program*, and found that compliance with the acceptance criteria was

[91] 24590-LAW-RPT-ESH-01-001, *Preliminary Fire Hazards Analysis for the Low-Activity Waste Building*; 24590-HLW-RPT-ESH-01-001, *Preliminary Fire Hazards Analysis for the High-Level Waste Building*; 24590-PTF-RPT-ESH-02-001, *Preliminary Fire Hazards Analysis for the Pretreatment Building*; 24590-BOF-RPT-ESH-01-002, *Preliminary Fire Hazards Analysis for the Balance of Facilities*.

conditionally acceptable. Two of the five criteria were acceptably met and three were conditionally met. The evaluation of the information is summarized below:

1. The reviewers found the information on the comprehensiveness of the fire protection program to be conditionally acceptable based on the following:

   (a) The fire protection program provided for the control of fire hazards through (1) policies for limiting combustibles in quantity and configuration; (2) safe containment of combustibles, flammable gasses and liquids; (3) control of ignition sources; (4) periodic safety inspections; and (5) safe hot work procedures.

   (b) The fire protection program provided requirements for tracking impairments to fire protection systems, including using appropriate compensatory actions until the impairments are corrected; recording impairments in an approved tracking system; correcting impairments on an expedited basis; and reporting impairments according to DOE M 232.1-1A, *Occurrence Reporting and Processing of Operations Information*.

   SRD Safety Criterion 4.5-19 requires that administrative controls be established to minimize fire hazards, including procedures that establish compensatory controls for activities that could impair fire prevention and/or mitigation features.

   Reviewers questioned (Question LAW-PSAR-218) what procedures were in place for performing periodic safety inspections; inspecting and tracking fire barrier penetration seals, doors, dampers, and related devices. In response to Question LAW-PSAR-218, BNI committed to have these procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program. These procedures were intended to address requirements from NFPA standards for (1) periodic inspection and maintenance of fire barriers; (2) fire barrier protection systems, such as penetration sealants, fire doors, and dampers; and (3) the periodic testing and operation of the fire water system, sprinkler systems, standpipe systems, fire alarm and evacuation systems, and safe egress from facilities to ensure their continued operation and reliability. This commitment was acceptable to the reviewers.

   (c) For the WTP facilities, the fire protection program required systematic fire hazard analyses that subdivide the facilities into discrete fire areas and evaluate the fire safety of each area.

   (d) The fire protection program included the requirement for developing and using prefire plans that addressed fire response and fire fighting responsibilities, locations of fire protection equipment and concentrations of combustibles, and areas restricted for the use of water for fighting fires.

   (e) The fire protection program included the requirement for a Life Safety Code Evaluation report for the LAW, HLW, and PT facilities that documented conformance to NFPA 101, "Life Safety Code."

2. The reviewers found the program's information on personnel qualifications and experience for positions involved in fire protection functions to be acceptable.

   (a) The fire protection program addressed the training of construction, operating, and support staff to recognize fire hazards, perform work in a fire-safe manner, and respond safely and effectively to fire or related events.

   (b) The fire protection program identified the ES&H manager as being responsible for the principal overview of the program and the engineering manager as being responsible for design to fire protection standards and codes identified in the SRD.

   (c) The engineering manager was supported by a competent fire protection engineering staff that met stringent qualification standards and was assuring conformance of design through review of drawings, specifications and acceptance test procedures having impact upon fire safety. Design reviews and acceptance tests were documented.

3. The reviewers found the WTP fire protection program (24590-WTP-PL-ESH-02-004) conditionally acceptable. The program was reviewed for the attributes of a complete fire protection program, including organization and management control systems, training and qualifications, fire prevention, and fire protection features and systems. The results of the evaluation are described below:

   (a) SRD Safety Criterion 4.5-18 requires a comprehensive, documented fire protection self-assessment program, which includes all aspects (program and facility) of the fire protection program. In addition, SRD Safety Criterion 4.5-16 requires a plan to identify, prioritize, and monitor the status of fire protection-related appraisal findings and recommendations. The WTP fire protection program identified the ES&H manager as being responsible for conducting fire protection program self-assessments to monitor program implementation. Reviewers questioned (Question LAW-PSAR-218) what procedures were in place for performing periodic evaluations of the overall WTP fire protection performance and for identifying and tracking fire safety issues. In response, BNI committed to have these procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program. This commitment was acceptable to the reviewers.

   (b) The WTP fire protection program required each facility to have an Emergency Action Plan addressing safe facility shutdown and egress, personnel accountability, reporting of fires and other emergencies, and interactions with emergency responders, such as the Hanford Site Fire Department. In addition, the reviewers identified that a Service Agreement (FH-0104454, "Emergency Preparedness and Hanford Fire Department Summary of Work Scope") and Memorandum of Agreement (No. 091001-01) were in place between BNI and the Hanford Fire Department to ensure that emergency services, including ambulances, fire trucks, hazardous material trucks and equipment, and trained

personnel, will be available to the WTP construction site 24 hours a day to respond to fires, accidents, or a hazardous materials spill. In responses to Questions PFHA-LAW-16 and PFHA-BOF-004 and -007 concerning the adequacy of emergency response services, BNI stated that the results of the updated *Hanford Site Emergency Response Needs Assessment* will be reviewed for adequacy of protecting the WTP facilities and included, as necessary, in the final fire hazards analyses. This was acceptable to the reviewers because it indicated that the fire hazards analyses to support facility operations will be based on an updated baseline needs assessment that accounts for the fire risks posed by the WTP.

(c) The WTP fire protection program included requirements for a fire prevention program based on basic fire safety training of employees, control of ignition sources and combustible loading, the use of established procedures to minimize the potential for fires through a combination of housekeeping practices, periodic safety inspections, fire protection equipment maintenance and testing, and control of flammable and combustible materials. SRD Safety Criterion 4.5-19 required such a program, stating that fire prevention procedures provide for safety-driven housekeeping practices that limit accumulation of combustible materials that can initiate or cause the spread of fire within the facility. In response to Question LAW-PSAR-215 concerning which procedures implement the fire prevention program, BNI identified that procedure 24590-WTP-GPP-SIND-026, *Housekeeping and Fire Prevention*, was currently implemented and committed to fully implement the fire prevention program as part of the March 1, 2003, implementation plan for the WTP fire protection program. BNI further committed to revise its Non-Radiological Worker Health and Safety Plan to include the relevant fire protection requirements from Subparts F and J of 29 CFR 1926, "Safety and Health Regulations for Construction," to ensure that an adequate set of fire safety requirements were specified for work at the WTP construction site. These commitments were acceptable to the reviewers.

4. The reviewers found that WTP structures containing ITS systems or components, used as minimum criteria, the construction classifications of the 1997 UBC, including the UBC, Section 104.2.8 provisions for alternate materials, design and methods of construction. DOE O 420.1A, Section 4, "Requirements," requires all new construction to conform, as a minimum, to the Model Building Codes applicable for the state or region. The Washington Administrative Code (WAC), Section 51-40-003, states that the 1997 edition of the UBC, as published by the International Conference of Building Officials, is adopted by reference. The SRD, Appendix C, Section 4.0, "DOE G-420.1/G-440.1, Implementation Guide for Use with DOE Order 420.1 and 440.1, Fire Safety Program," identified the 1997 UBC as the applicable building code for the WTP project.

However, in parallel with the CAR review, BNI prepared an equivalency request to the requirements of UBC 1997 (24590-WTP-RPT-AR-02-001, *Performance-Based UBC Type II, F.R. Equivalency for the LAW, HLW, and PTF Buildings*) to justify and allow use of the unlimited height and area allowances for Type I, F.R. construction, while classifying the three WTP process buildings as Type II, F.R. The equivalency is still in

DOE review; however, the reviewers found that the equivalency proposed construction classification requirements per the 1997 UBC based on consideration of the following:

- The noncombustible or fire-resistive construction of the WTP process buildings.

- The extensive compartmentalization of the process buildings into discrete 2-hour rate fire areas, such that postulated fires would affect only a limited portion of the building structure. The combustibles identified for these fire areas were quantified based on the preliminary design of the buildings and were evaluated by the building-specific PFHA, as discussed further in Item 5 below.

- Extensive use of automatic sprinkler systems throughout the process buildings, except for potentially contaminated, inaccessible (C5/R5) areas in which no surveillance, testing, or maintenance of fire protection systems could be performed. BNI was processing a request for DOE approval of alternate fire protection safety criteria to the requirements of DOE O 420.1A to allow for automatic sprinkler systems to be excluded from the WTP C5/R5 areas.

- Protection, such as fire proofing, of the process building's primary structural frame to withstand the effects from fires of up to 2 hours in duration within the affected fire areas.

- Wide applicable of smoke detection systems, beyond that required by consensus fire protection codes (e.g., NFPA 72, "National Fire Alarm Code"), to provide early warning of fire events and notification to the Hanford Site Fire Department.

- Separation of building occupancies (e.g., factory/industrial, hazardous, storage, and business) by walls rated for 2-hour fires, including penetrations, doors, etc.

Pending DOE action on the requested equivalency to the requirements of UBC 1997, BNI is expected to comply with the requirements of DOE O 420.1A and the SRD. Accordingly, as a condition of construction of the LAW, HLW, and PT buildings, BNI should not preclude compliance with the requirements of the 1997 UBC unless relief has been granted by DOE approval of the requested equivalency.

The reviewers found acceptable the LAW, HLW, PT, and BOF PFHAs descriptions of the construction of the walls that function as fire area fire barriers, including walls to grade, and the analysis of postulated fire scenarios that could challenge the structural integrity of these walls/fire barriers. The following provides more detail on that evaluation:

(a) The reviewers found the description of the construction materials to be acceptable. All buildings materials were noncombustible or fire-resistive, except for the special protective coating to be used for ease of decontamination in areas processing or storing radioactive materials. This coating will be tested to meet the "limited-combustible" requirements of NFPA 801. BNI specification 24590-WTP-3PS-AFPS-T0002, *Engineering Specification for Special Protective*

Coating Limited Combustible Testing Protocol, was found to require the "limited combustibility testing to be performed in accordance with NFPA 259, 'Standard Test Method for Potential Heat of Building Materials.'" This approach was acceptable to the reviewers.

(b) The reviewers found the description of fire confinement systems to be acceptable. The fire area drawings showed adequate confinement systems to prevent spread of fire throughout the buildings or from one fire area to another. The reviewers identified that the HLW, LAW, and PT buildings were adequately compartmentalized by their separation into multiple discrete fire areas, each fully surrounded by 2-hour, fire-rated construction. SRD Safety Criterion 4.5-3 requires confinement of a fire to its origins through the design of passive barriers. The PFHAs did not describe the fire ratings intended for building process bulge walls. In response to Question HLW-PFHA-004 requesting this description, BNI stated that equivalencies would be requested, as necessary, to qualify any non-rated fire barrier, including process bulges. Because the SRD implementing codes and standards permit equivalencies when adequately justified and documented and contain requirements for the Contractor to request equivalencies, the reviewers found this response acceptable.

(c) The reviewers found the information on the protection of redundant SDC systems and components from fires to be acceptable. DOE O 420.1A, Section 4.2.2.4, requires that for new facilities "redundant safety class systems shall be in separate fire areas." SRD Safety Criterion 4.5-5 specified this requirement for the WTP. The reviewers found that redundant SDC systems and components were located in separate fire areas. However, this same conclusion could not be reached for the ITS power and control cables associated with these SDC systems and components. Details of the cable routings and separation for protection against failure due to a single fire event were not available when the facility PFHAs were developed. However, BNI submitted a request for DOE approval of alternate nuclear safety design criteria, 24590-WTP-RPT-ESH-02-007, *Fire Protection Exemption Request-Fire Rated Cable Assemblies and/or Fire Rated Enclosures*, on this issue in parallel with the CAR. This request proposed to (1) use fire-rated cables installed according to the listed configuration, which could include providing protection of the raceway and support; and/or (2) construct fire-rated enclosures to separate raceway installed cable from redundant SDC cable located within the same fire area. This request addressed cables meeting the definition of safety class according to DOE O 420.1A. DOE determined that additional information must be submitted to clarify the specific locations and identify cables that cannot be separated, and this information was not expected to be available for six to twelve months. Pending review and disposition of this request, the Contractor design will be subject to the SRD Safety Criterion 4.5-5 requirement.

(d) The reviewers found that hazards unique to the facility had been separated from other building occupation areas by appropriate fire resistive construction. This was acceptable to the reviewers.

(e) The reviewers found that BNI preliminary estimates of combustible materials located in the facility fire areas were conservative and would not challenge the 2-hour fire rating of the fire barriers enclosing the fire areas, including fire-rated penetrations through the barriers. This was acceptable to the reviewers.

5. The reviewers found the PFHAs to be conditionally acceptable. The PFHAs conformed to the requirements of DOE O 420.1A and NFPA 801, the implementing codes and standards for the Safety Criteria in SRD Section 4.5. The results of the evaluation are discussed below:

(a) The reviewers found the PFHAs acceptable because they comprehensively addressed the site description; site fire protection features and systems; emergency planning and fire department response capabilities; site security; building construction descriptions; life safety considerations; building fire protection features; protection of ITS SSCs, including equipment required to achieve and maintain a safe facility state; the effects of significant fire safety deficiencies; and special topics. Special topics included cable tray fires, control of transient combustible materials, spurious actuation of equipment, nonstandard penetration assemblies, fire barriers and protection of penetrations, the impact of NPHs on facility fire safety, the potential for a toxic or radiological incident due to a fire, and compensatory measures for impairments to fire protection systems.

(b) The reviewers found the characterization of fire hazards to be conditionally acceptable because the analysis of each fire identified fixed and transient (associated with maintenance or similar activities) combustibles, ignition sources, ITS and safe state equipment, exposure fire potential and the potential for fire spread between adjacent fire areas, evaluation of the design basis/bounding fire scenario for the area, and the potential for a toxic or radiological release due to the fire. In addition, the design basis fire scenario evaluation included the consequences from the fire taking into consideration that the fixed fire suppression system failed to operate.

Citing SRD Safety Criteria 4.5-3 and 4.5-9, the reviewers questioned (Question PT-PSAR-073) why 75°F was used for ambient air temperature from the other areas in the resulting air temperature calculation in Appendices E.3 and E.8 of the *Preliminary Fire Hazards Analysis for the Pretreatment Building* (24590-PTF-RPT-ESH-02-001). The reviewers noted that the C5 area HVAC system is being designed to normally maintain the C5 area at a temperature greater than 75°F (in calculations 24590-PTF-MAC-C5V-00001 and –00002, *PTF C5V HVAC Load Calculation* and *PTF C5V HVAC Equipment Sizing and Selection*, respectively); normal cooling is 113°F. The normal temperature would result in a higher exhaust air temperature entering the HEPA filters. BNI responded that the assumption was made in the absence of detailed design information. BNI's response also stated that more recent data determined that the ambient air temperature will be 113°F, which is well within the available margin to protect the silicone seals on the C5 HEPA filter cartridges. BNI committed to revise the analysis in Appendices E.3 and E.8 of the Fire Hazard Analysis with the first

PSAR revision following authorization for full facility construction. The reviewers found the BNI response and commitment to revise the PFHA calculations to reflect the higher normal operating temperature to be acceptable because the higher temperatures are not expected to significantly affect the performance of the radial HEPA filters.

(c) The reviewers found the PFHA conclusions to be conditionally acceptable based on the information, descriptions, assumptions, and analysis presented in the facility PFHAs and in BNI responses to questions. The PFHAs concluded that each postulated fire within the HLW, LAW, PT, or BOF building would be contained within the involved fire area; would not result in radiological or toxic releases that exceeded limits defined in the SRD, Section 2, "Radiological and Process Standards"; would not result in the loss of more than a single item of redundant ITS equipment; and would not preclude the ability to achieve and maintain safe state conditions within the facilities, with the following exception. SRD Safety Criterion 4.5-20 requires that the fire hazard analysis confirm that the facility can be placed in a safe state during and after all credible fire conditions. However, the HLW PFHA stated that products of combustion may result in a loss of multiple offgas booster extract fans in room H-B001C and the booster pre-heater in room H-B001A. In response to Question HLW-PFHA-037 relative to this potential loss, BNI stated that, if these components were lost because of the products of combustion, the melter would be put in an idle position and operations would stop. Any subsequent offgas release would be contained by the operating C5 ventilation system and safe state would be established. In addition, BNI committed to include this information in Chapter 2 of the HLW PFHA with the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable because the PSAR will be revised to clearly state how safe conditions will be achieved and maintained before this equipment is installed in the facility.

3.18.3 Conclusions

The reviewers found the WTP fire protection program (24590-WTP-PL-ESH-02-004) to be conditionally acceptable because it was comprehensive and compliant with SRD safety criteria. The reviewers found that LAW, HLW, and PT walls were adequate as fire barriers, based on the PFHAs. The reviewers also found that the PFHAs for these facilities, although based on preliminary design information and estimations of fixed and transient combustible loadings, were comprehensive evaluations of the fire hazards within the buildings, including the radiological and toxic hazards and consequences associated with postulated fire events and were acceptable for full facility construction authorization.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Have procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program for performing periodic safety inspections; inspecting and

tracking fire barrier penetration seals, doors, dampers, and related devices, as committed to in response to Question LAW-PSAR-218. (See Section 3.18.2, Item 1[b].)

2. Have procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program for performing periodic evaluations of the overall WTP fire protection performance and for identifying and tracking fire safety issues, as committed to in response to Question LAW-PSAR-218. (See Section 3.18.2, Item 3[a].)

3. Fully implement the fire prevention program as part of the March 1, 2003, implementation plan for the WTP fire protection program; and revise the Non-Radiological Worker Health and Safety Plan to include the relevant fire protection requirements from Subparts F and J of 29 CFR 1926, "Safety and Health Regulations for Construction," to ensure that an adequate set of fire safety requirements are specified for work at the WTP construction site, as committed to in response to Question LAW-PSAR-215. (See Section 3.18.2, Item 3[c].)

4. As a condition of construction of the LAW, HLW, and PT buildings, BNI should not preclude compliance with the requirements of the 1997 UBC unless relief has been granted by DOE approval of the requested equivalency. (See Section 3.18.2, Item 4.)

5. Revise the analysis in Appendices E.3 and E.8 of the PT PFHA with the first PT PSAR revision following authorization for full facility construction to reflect an ambient temperature of 113°F, as committed to in response to Question PT-PSAR-073. (See Section 3.18.2, Item 5[b]).

6. Include in Chapter 2 of the HLW PFHA, with the first PSAR revision following authorization for full facility construction, the information on the ability to achieve and maintain a safe state after the loss of the melter offgas system components due to credible fire scenarios, as committed to in response to Question HLW-PFHA-037. (See Section 3.18.2, Item 5[c].)

4.0 EVALUATION – FACILITY-SPECIFIC DESCRIPTION

This section discusses the facility-specific information submitted by BNI in the following five submittals:

- 24590-WTP-PSAR-ESH-01-002-03, *Preliminary Safety Analysis Report to Support Construction Authorization; LAW Facility Specific Information,* Revision F, January 31, 2002

- 24590-WTP-PSAR-ESH-01-002-04, *Preliminary Safety Analysis Report to Support Construction Authorization; HLW Facility Specific Information,* Revision H, February 19, 2002

- 24590-WTP-PSAR-ESH-01-002-02, *Preliminary Safety Analysis Report to Support Construction Authorization; PT Facility Specific Information,* Revision E, May 1, 2002

- 24590-WTP-PSAR-ESH-01-002-05, *Preliminary Safety Analysis Report to Support Construction Authorization: Balance of Facility Specific Information,* Revision F, February 19, 2002

- 24590-WTP-ABCN-ESH-02-14, *Revision to the BOF PSAR adding facilities/systems to the Construction Authorization Request,* Revision 0, April 30, 2002.

Results of the individual facility evaluations are discussed in the following sections for the LAW, HLW, PT, and BOF facilities.

4.1 LAW Facility

The scope of activities covered in the PSAR, Volume III, *LAW Facility Specific Information,* is construction of the LAW facility. Construction will be accomplished in three phases: basemat construction, walls to grade construction, and full facility construction. Each phase is separately evaluated and authorized by ORP.

4.1.1 LAW Facility Description

The purpose of this review was to determine whether the submittal adequately described the LAW facility and processes that were encompassed by the PSAR and that could affect any safety functions, hazards, or potential accidents (at the completed facility) and their consequences. Examples of facility features are facility location, facility design information, and the location and arrangement of the LAW building on the WTP facility site. Examples of process features are the general arrangement, function, and operation of major components of the processes for treating LAW.

4.1.1.1 Requirements

The requirements for the facility and process descriptions are described separately below.

Facility Description – The facility features facility required for the LAW facility description parallel features listed previously in Section 3.2.1 but as uniquely applied to the LAW facility: (1) facility location, (2) facility site's layout and location of buildings, (3) the facility's ability to resist failures of ITS SSCs, (4) imposed design limits for quantifying the structural behavior of the concrete and steel structures, (5) design and analysis processes used for ITS structures, (6) ITS electrical systems and components, (7) ventilation and air cleaning systems and components, (8) protection of control room atmospheres, and (9) effluent stacks. (See Section 3.2.1 for a more detailed statement of required information for the facility description and references to source documents for these requirements.) The descriptions were reviewed against criteria in RL/REG-99-05, Sections 1.2, "Facility Description."

Process Description – DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," contains the requirements for the process description and requires the Contractor to design the facility to (1) comply with the design-related portion of the updated SRD and (2) properly account for the natural and man-made external events associated with the site. The process description was acceptable if it was presented at a level of detail appropriate to support the hazard and accident analysis, if it identified and described the features that were ITS, and if the criteria (from RL/REG-99-05, Section 1.3, "Process Description,") as outlined below were met:

1. The basic theory of the process was generally discussed and an overview of the following was provided: operating logic, process flow diagrams, chemical formulae, reaction equations, radiolytic reactions, feed constituents, reagents, products, byproducts, effluents (solid, liquid, and gaseous), and other waste streams.

2. The general arrangement, function, and operation of major components in the process were provided.

3. Process design, materials of construction, equipment design, process control logic, and control instrumentation were discussed in sufficient detail to understand the hazard and accident analyses.

4. The operating ranges and limits were provided for measured process variables (e.g., temperature, pressures, flows, and compositions) used in engineered or administrative controls as required to demonstrate adequate safety. The process operating limits and ranges were consistent with those evaluated in the hazard and accident analyses as providing adequate safety.

5. Process equipment layout in the facility was provided in schematic drawings showing plan, elevation, and isometric views of process equipment locations in the facility.

6. The process design-related codes and standards and the implementation of these codes and standards were provided.

7. Instrumentation and controls required for monitoring the process and safely shutting down the process were provided. The design also provided information on the materials selected for vessels and piping. The materials selected were consistent with the use (e.g., expected temperatures and pressures); compatible with the chemicals, reactions, and radiation fields; and met the expected service life without exceeding corrosion and erosion allowances.

8. The facility process systems were designed to minimize the production of wastes and the mixing of radioactive and nonradioactive wastes.

4.1.1.2 Evaluation

Results of the evaluation of facility and process descriptions for construction of the LAW facility are summarized separately below.

Facility Description – The reviewers found conditionally acceptable the LAW facility location and design descriptions provided in PSAR Volume III, Sections 2, 3, and 4; calculation reports; and other documents referenced in the PSAR. The reviewers found that the submittals acceptably met six of the nine criteria and conditionally met three criteria. The evaluation of the information for each review criterion is summarized below:

1. Information on facility location was evaluated in Section 3.2.2.1 of this SER and was found to be acceptable.

2. The reviewers found the layout and location of the LAW building, as described in PSAR Section 2.3.2, to be acceptable and at a level of detail consistent with the preliminary level of design.

3. The reviewers found conditionally acceptable the information on the ability of the structural design to resist failures of ITS functions of the structures due to credible internal and external events, as discussed in PSAR Chapter 2. Specific reviews were conducted to evaluate the adequacy of BNI's structural design of the LAW basemat and walls to grade. BNI's design of the remainder of the LAW building and equipment had not been completed and therefore could not be reviewed. However, the method of design, as presented in the PSAR and referenced standards in 24590-WTP-DC-ST-01-001, *Structural Design Criteria*, was reviewed and found acceptable.

   Reviewers concluded that BNI's implementation of these design methods and standards to a degree of rigor comparable with that used in the design of the basemat and walls to grade can be expected to result in an acceptable LAW facility structural design. The following specific reviews were conducted:

   (a) The reviewers found acceptable the choices and specific information pertaining to required codes and standards as presented in Table 1 of 24590-WTP-DC-ST-01-001. These codes and standards met the requirements of SRD Safety Criterion 4.1-4, the applicable criterion for an SDS structure such as the LAW facility.

(b) The reviewers found acceptable the NPH safety classification of the LAW facility to ensure its safety function without failure as SC-III for seismic events and performance category (PC) 2 for other external events. These designations were acceptable to the reviewers because they were consistent with SRD Safety Criterion 4.1-4 and with PSAR safety analyses discussed in Section 4.1.2 of this SER. The safety analyses found that a radiological accident in the facility would result in exposures well below the SRD Safety Criterion 2.0-1 dose standards. Therefore, no SC- I or -II SSCs were required per SRD Safety Criterion 4.1-3.

(c) The reviewers found acceptable the load factors and load combinations for the structural steel and concrete as found in 24590-LAW-S0C-S15T-00007, *Load Combinations*, and for the walls to grade as provided in 24590-LAW-DBC-S13T-00011, *Basement Wall Design*, because they were consistent with the requirements of SRD Safety Criterion 4.1-4 implementing codes and standards, e.g., ACI 318-99, *Building Code Requirements for Structural Concrete*; AISC-ASD, *Manual of Steel Construction, Allowable Stress Design*; and the 1997 UBC.

(d) The reviewers found acceptable the definition of the specific loads encountered during normal plant construction, startup, operation, and shutdown, including dead loads, live loads, thermal loads, snow loads, ashfall loads, and lateral earth pressure and wind loads.[92] In response to Question LAW-PCAR-065 concerning the margins of design and in calculation report 24590-LAW-DBC-S13T-00011, BNI summarized the structural evaluation results by tabulating the demand/capacity ratios at several critical locations for the load combinations that controlled basemat and walls to grade design. The reviewers found the methods used and results of these calculations acceptable because all the demand/capacity ratios were <1.0.

(e) Creep and shrinkage forces were not addressed in Volume III of the PSAR. However, in response to Question LAW-PCAR-090 concerning the shrinkage of concrete, BNI stated that many years of experience by WTP project engineers have determined that reinforced concrete structures of the magnitude and layout configuration similar to the WTP facilities have not had excessive shrinkage cracking by limiting the maximum temperature of the concrete at placement to 70°F. BNI further stated that construction procedures consider the length and size of concrete pours, sequence of construction, potential cooling of the aggregate, and time of placement; and the concrete design complies with the minimum requirements for shrinkage reinforcement. Subsequently, and before completion of the PSAR review, BNI also reviewed, per FCR 24590-WTP-FCR-C02-070, *Concrete Placement Temperature*, construction plans and procedures to minimize

[92] 24590-DDBC-S13T-00011, *Basement Wall Design*; 24590-LAW-DBC-S13T-00001, *Foundation Wall Calculations for Lateral Soil Loads*; 24590-LAW-DBC-S13T-00002, *Elevator Pit Wall Calculations for Lateral Soil Loads*; 24590-LAW-DBC-S13T-00003, *Differential Settlement in Basemat Foundations*; 24590-LAW-DBC-S13T-00005, *Thermal Analysis for Basemat and Pour Cave Walls*; 24590-LAW-S0C-S15T-00002, *LAW Floor Loading*; 24590-LAW-S0C-S15T-00005, *Wind Loads on the Building*; and 24590-LAW-S0C-S15T-00006, *Snow and Ash Load*.

any adverse effect of shrinkage through placement arrangement and sizes. Based on this, the reviewers found this response acceptable.

(f) The reviewers found acceptable the calculated loads resulting from a design basis earthquake, from an accidental spill of molten glass onto the basemat, and from accidental drops of heavy objects onto the basemat and floors. The reviewers found the evaluation of the accidental impact of aircraft into the LAW building to be conditionally acceptable. The reviewers' evaluation of the seismic calculations is discussed in Section 4.1.2 of this SER.

For the accidental molten glass spill and in responses to Questions LAW-PCAR-084 and -088 concerning thermal effects of glass spills on the facility, BNI committed to provided sufficient additional rebar in the basemat and walls in the vicinity of the glass spill area so that the cracks that may result from the postulated accidental molten glass spill do not propagate to the walls, and the basemat and the walls retain their ability to support the melters, offgas system, and stacks. Subsequently, and before completion of the PSAR review, BNI modified the design to add rebar to critical support areas of the basemat below the melter support walls per CCN: 042912.[93] The reviewers found the design modification to support the melters acceptable.

To demonstrate that the basemat and walls could perform their safety function, (i.e., support the offgas system, the melter, and the ventilation stack), BNI provided calculation report 24590-LAW-DBC-S13T-00014, *Basemat Analysis for Glass Spill.* This calculation showed that the basemat could withstand the thermal loads with limited damage and still perform its safety function. In the calculation, a structural analysis of the basemat and the walls was performed in the vicinity of the glass spill by assuming that a small segment of the basemat, representing the glass spill location and size, loses all its strength due to the hot glass contact. The calculation was done with a 7 x 10 ft segment of elements removed from the basemat model to represent the concrete area damaged by the glass spill. BNI concluded, and the reviewers agreed, that little effect occurred on the basemat loading and no significant change occurred to the ability of the basemat and walls to perform their safety function. The reviewers found acceptable this approach for demonstrating the structural adequacy of the basemat and walls to support the melter, offgas system, and the stack.

For accidental drops of heavy objects onto the basemat and floors, the location of the postulated drops, maximum drop heights, and the calculated severity levels to the facility worker were documented in a BNI internal memo,[94] which was included as an attachment to the basemat structural calculation report 24590-

[93] CCN: 042912, BNI internal memo, M.A. Scott, to B. Spezialetti, "Response to Action Item #2 of Conditions of Acceptance for the LAW PSAR Construction Authorization, ref: ORP/OSR-2002-18, Rev A dated 06/14/02," dated October 15, 2002.
[94] CCN: 023642, BNI internal memo, J. Hinckley to S. Thomson, "Load Drop Scenario for LAW," dated September 28, 2001.

LAW-DBC-S13T-00010, *Load Drop Evaluation*. The impact to the basemat and walls for the worst-case load drop (canister drop) was evaluated and showed that the structural damage would be acceptable. Considering that no local functional safety requirements (confinement criteria) were required for the basemat, the reviewers found the load drop analysis acceptable.

The reviewers found the evaluation of the accidental impact of aircraft onto the LAW building to be conditionally acceptable. The accidental impact of aircraft onto the LAW building was evaluated in calculation report 24590-WTP-Z0C-50-00001, *Accident Analysis for Aircraft Crash into a RPP-WTP Facility.* In this calculation, BNI used the methodology and criteria given in DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. The reviewers found the use of this standard acceptable because it provides guidance and data specific to DOE facilities. In Revision A of calculation report 24590-WTP-Z0C-50-00001, the aircraft impact frequency was calculated using the entire LAW building as the target, and the impact frequency was determined to be more than the frequency threshold value of 1×10^{-6}/yr given in DOE-STD-3014-96. As such, credit was taken for the concrete walls and floors to act as impact barriers to protect most ITS SSCs. The impact frequency was then recalculated using the reduced target area based on only ITS SSCs that are not protected by concrete walls and floors.

The calculation did not completely establish the structural effectiveness of the floors and walls as impact barriers, as was noted in Questions LAW-PSAR-153 and PT-PSAR-220. In response, BNI revised the calculation (Revision B) and stated that the public radiological and chemical exposures that may potentially result from accidental aircraft impact on the LAW building are much less than the exposure threshold values given in SRD Safety Criterion 2.0-1 for the public. The reviewers noted that BNI did not calculate exposures to facility workers and co-located workers. However, BNI justified not performing such an evaluation in a revised response to Question LAW-PSAR-153. The reviewers found BNI's justification acceptable because it was consistent with the guidance in DOE-STD-3014-96. In the response to LAW-PSAR-153, BNI committed to include, in the first PSAR revision, this evaluation of the aircraft impact on the LAW building and associated justification as stated in the response. The reviewers found this commitment acceptable.

4. The reviewers found acceptable the structural demands and strength capacities for each combination of factored loads for the LAW basemat, as provided in calculation reports 24590-LAW-DBC-S13T-00009, *Foundation Basemat Design*, and 24590-LAW-DBC-S13T-00011, Revision 0. Exterior walls were added to calculation report 24590-LAW-DBC-S13T-00011 as Revision 1 and interior walls were added as Revision 2 to address walls to grade. (BNI's design of the remainder of the LAW building and equipment had not been completed and therefore was not reviewed.) These calculations provided the detailed design of rebar necessary to meet the ACI 318-99 code strength requirements. The reviewers assessed the calculations specifically for required strength for each load combination; use of strength reduction factors for each design strength for flexure,

compression, shear, and tension; methods of determining controlling stress locations; minimum size and thickness requirements; rebar design and placement; rebar splice and embedment; and conservative factors to offset inaccuracies in computer model discretization and the simplification of analysis approximations. The reviewers found the methods and calculations acceptable because they were consistent with DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, and other applicable codes and all the demand/capacity ratios presented were equal to or less than 1.0.

5. The reviewers found the design and analysis processes to be conditionally acceptable as noted in the following specific evaluations:

   (a) The reviewers found the description of the computer code GTSTRUDL validation and verification in PSAR Section 2.4.8 to be acceptable because the validation was performed by using sample verification problems. The computer program GTSTRUDL was used for performing structural analysis of the LAW building, including the structural steel and concrete.

   (b) The reviewers found the finite element model of the LAW building and the resulting demands to be acceptable. Calculation reports 24590-LAW-S0C-S15T-00001, *GTSTRUDL Finite Element Analysis Model*; 24590-LAW-S0C-S15T-00009, *GTStrudl FEA Model Update #1*; and 24590-LAW-S0C-S15T-00010, *GTStrudl FEA Model Update #2,* were evaluated for the reasonableness of assumptions and results from the design and analysis process. The reviewers questioned (Question LAW-PCAR-093) the adequacy of the model discretization and the representation of soil pressure loads under the basemat. In response, BNI performed additional calculations, documented in CCN 031866,[95] and developed a method for ensuring that the demands (moments and shears) predicted by the GTSTRUDL model were appropriate.

   (c) The reviewers found the calculation reports 24590-LAW-DDC-S13T-00003, -00006, and -00011, *C3/C5 Drain Tank Embedment Analysis*, *C1/C2 Drain Tank Support Design*, and *Pour Cave Carousel Embedment Capacity,* respectively, to be acceptable design and analysis processes because the loads, design/analysis methods, and capacities used were consistent with Portland Cement Association code PCA EB 080, *Strength Design of Anchorage to Concrete*; DOE-STD-1020-94, and the applicable implementing codes and standards of SRD Safety Criterion 4.1-4.

   The reviewers found the calculation reports 24590-LAW-DDC-S13T-00010, -00011, and -00012, *Design of Exterior Wall Base Plate*, *Pour Cave Carousel Embedment Capacity,* and *Design of Interior Wall Base Plate*, respectively, to be conditionally acceptable. The reports were inconsistent in using cracked and uncracked concrete properties in the design of embedded plates. In several

[95] CCN: 031866, BNI letter, M. Scott to D. Houghton, BNI, "Responses to LAW Preliminary Construction Authorization," dated April 10, 2002.

instances, uncracked concrete properties were used without a proper basis. In response to Question LAW-PSAR-211 questioning this inconsistency, BNI committed to design anchorage using cracked concrete assumptions unless the structure is evaluated and determined to be uncracked. BNI stated that in the first PSAR revision, it will include its commitment to design anchorage using cracked concrete assumptions unless the structure is evaluated and determined to be uncracked. The reviewers found this commitment acceptable.

(d) The reviewers found acceptable the treatment of stress reversal from seismic loads in LAW building seismic calculations (calculation report 24590-LAW-DBC-S13T-00009 for the basemat design basis and 24590-LAW-DBC-S13T-00011 for the walls to grade design basis). Stress reversal from seismic loads was adequately accounted for in the load combination calculations.

(e) The reviewers found the treatment of localized and transient structural loads in designing and analyzing the basemat and walls to grade to be acceptable based on the method described in 5(b) above.

(f) The PSAR did not discuss the effects of various construction inspection levels on the design strength of the concrete and the construction methods used to account for concrete cracking due to shrinkage and other volume changes. However, in response to Question LAW-PCAR-090 concerning this issue, BNI described its construction procedures for accounting for cracking (see Item 3[e] above). The reviewers found the discussion to be acceptable.

(g) The reviewers found the information on the seismic spectrum for qualifying SDC equipment in the LAW building to be conditionally acceptable. The PSAR did not provide any information on the seismic spectrum to be used for qualifying SDC equipment in the LAW building required to perform its safety function following an earthquake, as required by DOE-STD-1020-94. In response to question LAW-PSAR-202 concerning this omission, BNI described and committed to the methodology to be used for qualifying SDC equipment in the LAW facility. BNI stated in its response that the first PSAR revision would describe the methodology to be used for qualifying SDC equipment in the LAW facility. The reviewers found the commitment to use this methodology acceptable because it was consistent with the DOE-STD-1020-94 and UBC methodology required by SRD Safety Criterion 4.1-4.

(h) The reviewers found the piping structural design methods for the offgas system to be conditionally acceptable. Table 2-6 in PSAR Volume I provided piping design criteria but did not identify design requirements for ITS piping in an SC-III building required to operate following an earthquake. In response to Question LAW-PSAR-201 concerning this omission, BNI stated that the ITS piping in the LAW facility will be designed to ASME B31.3, "Process Piping," occasional load criteria, and committed to include in the first PSAR revision, the design codes and code allowables for ITS piping and pipe supports in the LAW facility. The

reviewers found this commitment acceptable because it will ensure that the PSAR is consistent with SRD Safety Criterion 4.2-2, the applicable SRD criterion.

(i) The reviewers found the designation of seismic categories of cranes to be conditionally acceptable. The reviewers questioned (Question LAW-PSAR-200) the potential for cranes operating in the LAW facility above the SDC offgas system to fall on the offgas system components during an earthquake and how SRD Safety Criterion 4.1-3 requirements are satisfied in this case. Per SRD Safety Criterion 4.1-3, SSCs whose failure as a result of an NPH event could reduce the functioning of the SDC system are required to be designed to withstand NPH loadings. In response to Question LAW-PSAR-200, BNI committed to include in the first PSAR revision, designation of two cranes in the vicinity of the offgas system as SDS SC-III for their seismic safety function to prevent crane components or the bridge from falling on the SDC offgas SSCs. To protect against damage from the third crane (RWH-CRN-00008), BNI also committed to provide either a protective cage surrounding the offgas duct in the process area or, if a protective cage cannot be provided, designate the third crane also as SDS SC-III for its seismic safety function to protect the SDC offgas duct from falling crane components or the bridge. The reviewers found this commitment acceptable because designation of the cranes as SDS SC-III is consistent with SRD Safety Criterion 4.1-3 and implementing standard DOE-STD-1020-94.

6. The reviewers found the description of the LAW electrical system in PSAR Volume III combined with the general description of the electrical system in PSAR Volume I and additional drawings depicting LAW electrical loads to be acceptable and provided adequate information for hazard evaluation. PSAR Volume I described the overall electrical distribution system for the WTP facility, and Figure 2A-44 in PSAR Volume III provided the main electrical supply arrangement for the LAW facility. PSAR Volume III, Section 2.8, summarized the electrical arrangement in the LAW facility. Also, drawings depicting LAW electrical loads were provided.[96]

7. The reviewers found the information on ventilation and air-cleaning systems for the LAW facility to be acceptable, as discussed in PSAR Volume III, Section 2.6. The PSAR acceptably described the ventilation system and the approach to providing confinement barriers to protect the facility and co-located worker, the public, and the environment. The referenced codes and standards were compatible and consistent with SRD Safety Criterion 4.1-2, the applicable structural design criterion.

   Three general confinement zones were described, referred to by contamination zone classification zone designators C2, C3, and C5. Zone C2 areas were maintained uncontaminated but were adjacent to contaminated areas. Zone C3 included operating areas, which had low levels of contamination because of the work processes in them.

[96] 24590-SK-E-00014, "LAW Vit Power Distribution Main Single Line Diagram," Preliminary, April 3, 2002; 24590-SK-E-00015, "LAW Vit Power Distribution UPS Single Line Diagram," Preliminary, April 3, 2002; 24590-LAW-E8-LVE-00001, "Electrical Load List," Rev. 1, June 4, 2002.

Zone C5 included process enclosures and their ventilation system. The ventilation system includes the ductwork, filter trains, fans, stack, and controls that maintain the C5 confinement area at the lowest (most negative) pressure as related to atmosphere and as compared with the other confinement areas of the facility. This information was found to be acceptable.

8. The PSAR did not provide information on how LAW control room habitability was maintained under various accident conditions. In response to Question LAW-PSAR-207 to address this deficiency, BNI stated that the LAW control room was not being designed to be habitable during accidents that could introduce toxic chemicals or radioactive material into the control room. BNI stated that safety instrumented systems would be designed to automatically place systems in a safe state for the LAW facility. The LAW control room could be evacuated, as necessary, with no loss in the ability to respond to an emergency situation. The PT facility main control room would have monitoring and control capability to achieve and maintain a safe state for the WTP facility. In addition to the integrated control network supplying communication between the LAW control and monitoring system and the PT main control room, an appropriate control and monitoring capability for the LAW facility would also be available in the PT main control room. The PT main control room was being designed to remain habitable for all credible events and meet the requirements of SRD Safety Criterion 4.3-7. In addition, BNI was performing a detailed evaluation to further assess the impact of hazardous material releases on habitability in all WTP control rooms, including the time available for evacuation of the area.

BNI stated in its response that it would provide initial information (from ISM Cycle III) in the first PSAR revision and final information when the FSAR is submitted for the following:

(a) A detailed analysis of control room habitability for the facility (including the LAW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the LAW facility to place the facility in a safe state, and to evacuate the LAW facility safely

(b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the LAW design to identify LAW ITS controls and indications that must be provided in the PT control room design to ensure that the LAW can be placed and maintained in a safe state following any DBEs.

BNI also stated in its response that it would include the following commitment for the first PSAR revision:

(a) LAW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the LAW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4.

The reviewers found these commitments on control room habitability acceptable.

9. The LAW effluent stack was included in the GTSTRUDL structural model. However, no calculations were available for evaluating the strength of the LAW stack. The design methodology as presented in the PSAR and referenced standard was reviewed and found to be acceptable. The reviewers concluded that if this methodology is implemented with the same rigor as for the basemat and walls to grade, the adequacy of the stack to withstand NPH events and off-normal conditions that may arise during plant operation will be ensured. The ability of the structure to support the effluent stack was discussed in Section 4.1.1.2, Item 3(f), of this SER.

Process Description – The reviewers found conditionally acceptable the LAW process description provided in Sections 2, 3, and 4 of PSAR Volume III; documents referenced in the PSAR; and responses to reviewer questions. The reviewers found that the submittal acceptably met seven criteria and conditionally met one criterion. Evaluation of the information for each review criterion is summarized below:

1. The reviewers found conditionally acceptable the discussion of the basic theory of the process, the overview of the operating logic, process flow diagrams, chemical formulae, reaction equations, radiolytic reactions, feed constituents, reagents, products, byproducts, effluents, and other waste streams. PSAR Section 2.5 provided an overview of the process description for the LAW. Additional information on the control of glass melt properties was provided in response to Question LAW-PSAR-041, and the reactivity of two glass forming chemicals, lithium carbonate and boric acid, was discussed in response to Question LAW-PSAR-062.

   The reviewers questioned (Question LAW-PCAR-098) the possibility of mis-feed of HLW from PT to the LAW facility. In response, BNI committed to provide an additional control in the LAW facility. Specifically, the wet process cell walls would provide shielding to protect workers in the event of a mis-feed of HLW to the LAW facility. BNI stated in its response that in the first PSAR revision, the radiological shielding function of the wet process cell walls as an ITS function in the event of a mis-feed of HLW to the LAW facility will be described. The reviewers found this commitment acceptable.

2. The reviewers found acceptable the general arrangement, function, and operation of major components for the process, as described in PSAR Section 2.5 and associated drawings. Additional information on the operation of the exhausters to ensure that the safety function of the melter offgas system is maintained was provided in the responses to Questions LAW-PSAR-147 through -150.

3. The reviewers found the process design, materials of construction, equipment design, process control logic, and control instrumentation to be acceptable for understanding the hazard and accident analyses. The potential accumulation of radioactive material in process equipment was shown to have negligible effect on direct radiation doses in the responses to Questions LAW-PSAR-055 and -061. Additional information on the design and materials of construction of the melters and consumables change-out boxes to protect against direct radiation exposures was provided in the response to Question LAW-PSAR-

044. Further information on the composition of corrosive components of the melter offgas stream and materials of construction to be used in the offgas system was provided in the response to Question LAW-PSAR-047.

4. The reviewers found the level of definition of the operating ranges and limits of measured process variables to be acceptable and consistent with those evaluated in the hazard and accident analyses. The composition of the combustible and radioactive components of the melter offgas stream was discussed further in the responses to Questions LAW-PSAR-087 and -0164. Additional information on prior melter experience and testing was provided in the responses to Questions LAW-PSAR-048, -049, and -111. BNI's response to Question LAW-PSAR-048 stated that when the standby line is not in use, there is a continuous purge through the line and film cooler into the melter to guard against the potential for plugging. BNI's response to Question LAW-PSAR-049 stated that provision has been made to use water sprays and/or a mechanical device to clean the film cooler. The response to Question LAW-PSAR-111 stated that the pluggage of the submerged bed scrubber overflow line is extremely unlike based on experience with the West Valley submerged bed scrubber. Responses to Questions LAW-PSAR-057 and -058 discussed flowsheet uncertainties and the impacts of caustic leaching of waste solids in the PT building on the radionuclide compositions of wastes delivered to the LAW building.

5. The reviewers found the information on process equipment layout in the facility to be acceptable. PSAR Figures 2A-1, 2A-6, 2A-8, 2A-9, and 2A-37 provided schematic drawings of the layout and sufficient information for the PSAR review.

6. The reviewers found the description of process-related codes and standards to be acceptable and consistent with the requirements of SRD Safety Criterion 4.1-2. Reviewers found the codes and standards used for the design of LAW SSCs for NPHs, including seismic design, to be acceptable because they were consistent with SRD Safety Criterion 4.1-4. The response to Question LAW-PSAR-207 described how the requirements of SRD Safety Criteria 4.3-4 and 4.3-7 and their implementing codes and standards are applied to the control room. The response to Question LAW-PSAR-208 provided further information on how the requirements of SRD Safety Criteria 4.2-4, 4.3-1 through 4.3-4, 4.3-6, 4.4-4, 4.4-9 through 4.4-12, and 4.4.21 and their implementing codes and standards are applied to the LAW SDS and SDC systems. The implementing standards identified in the response were consistent with those SRD safety criteria.

7. The reviewers found the description of the design of instrumentation and controls for process monitoring and the safe shutdown of the process to be acceptable. Calculations of the largest credible melter offgas surge described in the response to Questions LAW-PSAR-045, -077, and -110 showed that the design and controls of the melter offgas system could accommodate the surge.

8. The reviewers found the descriptions of the design of the facility process systems for minimizing waste production to be acceptable. Descriptions to minimize the production of radioactive and nonradioactive wastes were addressed in 24590-WTP-PL-ENV-01-004, *River Protection Project – Waste Treatment Plant Environmental Plan*; PSAR Volume I, Section 9.3.2; 24590-WTP-PL-ENV-01-006, *WTP Environmental*

Radiological Protection Program - Draft, Section 8; and in various sections of 24590-WTP-PL-RT-02-001.

4.1.1.3 Conclusions

The conclusions for the facility and process descriptions are presented separately below.

Facility Description – The reviewers concluded that the requirements of the facility description for the PSAR as related to construction of the LAW facility were conditionally acceptable. The facility description was adequate to support the hazard and accident analysis for the LAW facility if the conditions stated below are met.

Conditions of Acceptance – BNI must include the following provisions in the PSAR. Except for Item 6 below, these provisions should be provided with the first PSAR revision following authorization for full facility construction:

1. Include the evaluation of the aircraft impact on the LAW building and associated justification, as committed to in response to Question LAW-PSAR-153. (See Section 4.1.1.2, Facility Description, Item 3[f].)

2. Include the commitment to design anchorage using cracked concrete assumptions unless the structure is evaluated and determined to be uncracked, as committed to in response to Question LAW-PSAR-211. (See Section 4.1.1.2, Facility Description, Item 5[c].)

3. Include the methodology to be used for qualifying SDC equipment in the LAW facility, as committed to in response to Question LAW-PSAR-202. (See Section 4.1.1.2, Facility Description, Item 5[g].)

4. Design ITS piping in the LAW building to ASME B31.3, "Process Piping," occasional load criteria, and include this commitment in the PSAR, as committed to in response to Question LAW-PSAR-201. (See Section 4.1.1.2, Facility Description, Item 5[h].)

5. Designate two cranes in the vicinity of the offgas system as SDS SC-III for their seismic safety function to prevent crane components or the bridge from falling on the SDC offgas SSCs. To protect against damage from the third crane (RWH-CRN-00008), provide either a protective cage surrounding the offgas duct in the process area or, if a protective cage cannot be provided, designate the third crane also as SDS SC-III for its seismic safety function to protect the SDC offgas duct from falling crane components or the bridge, as committed to in response to Question LAW-PSAR-200. (See Section 4.1.1.2, Facility Description, Item 5[i].)

6. Provide, as committed to in response to Question LAW-PSAR-207, initial information (from ISM Cycle III) in the first PSAR revision and full information when the FSAR is submitted, for the following (see Section 4.1.1.2, Facility Description, Item 8):

(a) A detailed analysis of control room habitability for the facility (including the LAW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the LAW facility to place the facility in a safe state, and to evacuate the LAW facility safely

(b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the LAW design to identify LAW ITS controls and indications that must be provided in the PT control room design to ensure that the LAW can be placed and maintained in a safe state following any DBEs.

7. Include the following commitment, as stated in response to Question LAW-PSAR-207: LAW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the LAW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4. (See Section 4.1.1.2, Facility Description, Item 8.)

Process Description – The reviewers concluded that the process description for the PSAR as related to the LAW facility was conditionally acceptable. The process description was acceptable to support the hazard and accident analysis for the LAW facility if the following condition was met.

Conditions of Acceptance – BNI must include the following provision in the first PSAR revision following authorization for full facility construction:

1. Include the radiological shielding function of the wet process cell walls as an ITS function in the event of a mis-feed of HLW to the LAW facility, as committed to in response to Question LAW-PCAR-098. (See Section 4.1.1.2, Process Description, Item 1.)

4.1.2 LAW Facility Hazard and Accident Analysis

The purpose of this review was to determine whether the submittals adequately described the hazard and accident analyses performed for the LAW facility and whether the analyses complied with the SRD and ISMP. The review also determined whether the analyses performed will provide adequate safety to protect the health and safety of the workers, the public, and the environment.

4.1.2.1 Requirements

According to the SRD, Appendix A, Section 4.0, "Hazard Evaluation," the submittal was to address the following nine elements of hazard and accident analyses: (1) identifying hazards, (2) identifying potential accident/event sequences, (3) estimating accident consequences, (4) estimating accident frequencies, (5) considering common-cause and common-mode failures, (6) defining DBEs, (7) defining the operating environment, (8) identifying potential control

strategies, and (9) documenting the hazard evaluation. In addition, the identification of assumptions and analysis of uncertainty were to be evaluated. The descriptions were reviewed against criteria in RL/REG-99-05, Section 4.4, "Hazard Analysis Results."

For internal DBEs, the evaluation for the LAW facility should assess the identification and analysis of internal DBEs that can affect the design of LAW ITS equipment and features and the overall facility.[97] For external DBEs, the evaluation should assess selection of the seismic and other external events for the LAW facility, including the seismic design criteria.[98] Facility preliminary seismic analyses should be evaluated to ensure that the preliminary LAW facility design will meet requirements for applicable loads when subjected to the design-basis earthquake. Consistent with the design's preliminary level, the evaluation should assess the chemical process safety of the LAW facility design and whether the submittals adequately identified and analyzed potential chemical hazards and accidents associated with the LAW facility.

4.1.2.2 Evaluation

The reviewers evaluated information provided in the PSAR, Section 3 and Appendix A, against the applicable criteria defined in the SRD and RL/REG-99-05. Relevant references in the PSAR were also reviewed to assess the scope, breadth, and depth of the detailed information underlying the discussion and to determine the completeness and accuracy of the information in supporting the conclusions. These references were also reviewed to determine the implementation and documentation of the ISM process as it applied to the LAW hazards and accident analysis results. These references included calculations, studies, drawings, system notebooks, additional detailed printouts from the SIPD database, system description reports, and other relevant supporting documentation.

The reviewers found the description of the LAW facility hazard and accident analysis acceptably met four of the nine elements and conditionally met five elements. The evaluation of the information for each review criterion is summarized below:

1. **Identifying Hazards** – The reviewers found the identification of hazards to be conditionally acceptable, as described in the PSAR, Appendix A CSD records; and in the hazard analysis results in 24590-WTP-RPT-TE-01-004, *Design Basis Event Selection for the Low Activity Waste Vitrification Facility.* The reviewers also evaluated BNI responses to Questions LAW-PCAR-008, -013, -018, and -049, which clarified the hazard analysis results. The reviewers evaluated this information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 1.

   For the LAW facility, PSAR Appendix A provided sufficiently complete lists of chemical and radiological hazards, potential consequences, possible causes, and estimated frequencies. The reviewers concluded that the PSAR adequately described the hazardous situations applicable to the operations and activities to be conducted in the LAW facility

[97] RL/REG-99-05, Section 4.5, "Internal DBEs."
[98] RL/REG-99-05, Section 4.6, "External DBEs."

and provided the information necessary to conduct thorough and accurate accident analyses to define DBEs and hazard control strategies for the LAW facility. The information provided, as supplemented by responses to reviewer questions and reviewed calculations, was consistent with the preliminary design of the facility and process.

However, the reviewers identified numerous discrepancies concerning the CSD record identification system used in SIPD and as referenced in the LAW PSAR text and tables, its hazard assessment report table (Appendix A), associated calculations, and drawings. The identification system of components had similar discrepancies. Individual components had different identification designators as referenced in the LAW PSAR text, figures, drawings, and CSD records. Questions LAW-PSAR-069, -095, and -0169 identified such discrepancies. These discrepancies initially created uncertainty in understanding hazards and identifying important components and increased the difficulty of cross-referencing or checking hazardous situations described in CSD records in different LAW documentation. Similar discrepancies occurred in the HLW PSAR. To correct these, BNI committed in its responses to Questions LAW-PSAR-069 and -169 to revise the PSAR and the safety documentation. As part of the authorization agreement for the LAW and HLW facilities walls to grade construction, BNI also agreed to correct the discrepancies related to the CSD records identification system used and referenced in the LAW and HLW PSARs texts and tables. Reviewers found this commitment acceptable.

PSAR Appendix A contained only the CSD records for hazards that have the potential to produce unmitigated radiological consequences above severity level (SL) 4 and chemical consequences above threshold, i.e., CSD records for SL-1, -2 and -3 events. In responses to Questions LAW-PCAR-049 and LAW-PSAR-065 concerning this observation, BNI stated that the complete listing of all hazards, including SL-4 hazards, was in 24590-WTP-RPT-TE-01-004 and that the PSAR only reported SL-1, -2, and -3 hazards. The reviewers found this acceptable. The reviewers evaluated the SL-4 events contained in 24590-WTP-RPT-TE-01-004 and found no SL-4 events that warranted elevation to a higher severity level category.

Because of the LAW facility's low radiological source term, the LAW facility was preliminarily categorized Hazard Category 3 using DOE-STD-1027-92, *Hazard Categorization, and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* The reviewers evaluated the basis for this categorization (24590-LAW-Z0C-U10T-00001, *Hazards Categorization for LAW*) and found it acceptable.

The PSAR identified potential hazards for the LAW facility in Appendix A CSD records, including their potential consequences, possible causes, and estimated initiating frequencies. In response to reviewer questions (Questions LAW-PCAR-039, -040, -043, -052, -055, -88, and -89 and LAW-PSAR-135), BNI also evaluated hazards from a molten glass spill from the melter and elaborated on hazards and controls associated with the mis-feed event (Questions LAW-PCAR-014, -051, -058, -98, and -099 and LAW-PSAR-056).

Based on LAW processes, design, and operations and analyses using the ISM process, BNI also systematically developed and compiled a list of hazardous and radioactive materials and energy sources associated with the LAW facility. These results for the LAW facility were documented in PSAR Appendix A and Sections 3.3.2.1 and 3.3.2.2. One radiological situation involving a liquid spill/overflow from the LAW concentrate receipt vessel (CSD-LLCP/N0002) could potentially result in an unmitigated dose of 5 rem to a facility worker (SL-2). For the co-located worker and the public, the resulting dose from this event (the bounding spill/overflow event) would be below threshold (SL-4). For chemical hazards, the PSAR identified several hazardous situations that could lead to unmitigated chemical exposures above threshold. SRD Safety Criterion 2.0-2 defines these as events that could reasonably be expected to result in a fatality or in-patient hospitalization of three or more facility workers or exposures above ERPG-3 levels for co-located workers. However, only the potential chemical accidents involving the release of untreated melter offgas into the facility, CSD-LLOP/N0001, had the potential to lead to unmitigated consequences above the chemical exposure standards of SRD Safety Criterion 2.0-2 for the worker and the co-located worker. No chemical releases were postulated to be above threshold for the public.

The safety functions of many of the LAW facility ITS SSCs (primary and secondary offgas system, piping and stack, and melter shell) depended on the structural capability of the LAW facility. The LAW structure supports all these ITS SSCs during normal, abnormal, and accident conditions. The principal hazards to the LAW structure are a seismic event or a molten glass spill. Other hazards considered were canister drops, liquid spills, and leaks and overflows from tanks.

The reviewers determined that the identification of radiological hazards, including those found in PSAR Section 3.3.2, was conditionally acceptable as discussed below. The reviewers found that the identification of hazards satisfied the requirements of SRD Safety Criteria 3.1-1 and 9.1-7; the SRD, Appendix A, Section 3.0, "Identification of Work"; and the SRD, Section 4.1, "Identification of Hazards."

The reviewers questioned two significant hazards associated with the adequacy of the LAW facility design. The first concerned the possible hazards of a mis-feed of HLW tank waste directly from the PT facility to the LAW facility (Questions LAW-PCAR-014, -051, -058, -98, and -099 and LAW-PSAR-056). In such an event, the radionuclide or hazardous chemical content in the feed could be higher than analyzed in the facility design. The reviewers noted that the SRD Safety Criteria 3.1-3 and 3.1-4 and the SRD, Appendix A, Section 4, "Hazard Evaluation," required the hazard analysis to determine the consequences and frequency of unmitigated releases of radioactive material and process chemicals resulting from the mis-feed event. In responses to Questions LAW-PCAR-098 and LAW-PSAR-056, BNI stated that the unmitigated consequences of this event were SL-1 to the facility worker and identified certain LAW process cell walls as an SDS SSC that would provide radiological shielding to limit the dose rate in occupied areas. BNI stated that it would include in the first PSAR revision the provision of gamma monitor activated automatic valve closure as an SDC SSC in the PT facility to prevent the mis-feed to the LAW facility and committed to designate certain LAW process cell

shield walls as SDS SSCs to mitigate the event. The reviewers concluded that these commitments were acceptable.

The second issue was the hazards of a molten glass spill onto the concrete basemat in the LAW facility pour cave. The reviewers questioned the thermal effect of a molten glass spill onto the basemat and the SSCs required to mitigate the thermal effects of the spill to the LAW facility, if any (Questions LAW-PCAR-039, -040, -043, -052, -055, -84, and -88 and LAW-PSAR-135). In response, BNI stated that it had performed additional thermal and structural calculations (CCN: 031866[99] and 24590-LAW-DBC-S13T-00005), to identify the bounding thermal effects. BNI found that the glass spill did not affect the overall structural integrity of the LAW facility structure (when redesigned to consider such thermal effects) and therefore did not impair the ability of the LAW facility to perform its safety function(s). The responses stated that the ITS function of the LAW facility structure was to provide structural support of both the offgas system and the ventilation stack, such that there would be confinement by the offgas system piping and unimpeded flow within the offgas system. Any local damage that might occur in the pour cave located in the LAW facility (under the melter) as a result of a molten glass spill would not affect the structure's stability or its ability to structurally support these ITS systems. The ventilation stack and offgas system also were routed away from the pour caves.

The reviewers found these calculations (CCN: 031866 and 24590-LAW-DBC-S13T-00005) to be acceptable, except for the temperature assumptions used in CCN: 031866. In the bounding molten glass spill scenario, the pour cave wall cooling panels were assumed not to be operating. However, CCN: 031866 assumed cooling panels on the pour cave walls were operating. In response to Question LAW-PSAR-163 concerning this inconsistency, BNI committed to confirm, using computational fluid dynamics analysis, that the concrete temperatures of the melter and pour caves could be maintained within design limits during a postulated accident scenario involving a molten glass spill with loss of cooling. Subsequently, and before completion of the PSAR review, BNI completed two CFD analyses: 24590-LAW-RPT-HV-02-002, *Preliminary Thermal/Ventilation Modeling for LAW Pour Cave With Additional Cooling Panels Based on Computational Fluid Dynamics Study*, and 24590-LAW-RPT-HV-02-001, *Thermal/Ventilation Modeling for LAW Pour Cave and Buffer Storage Area Based on Computational Fluid Dynamics Study*. Calculations include normal operation, loss of power (includes loss of HVAC and loss of coolant), and molten glass spill conditions. BNI summarized the results of these investigations and compared the resulting thermal conditions with those used in the final concrete design of the LAW facility in CCN: 042912.[100] In CCN: 042912 BNI concluded that with the added cooling panels the concrete temperatures for the off-normal cases, including a glass spill, are lower than normal cases previously analyzed. Therefore, BNI concluded, "the evaluation of the

[99] CCN: 031866, BNI letter, M. Scott to D. Houghton, BNI, "Responses to LAW Preliminary Construction Authorization," dated April 10, 2002.
[100] CCN: 042912, BNI internal memo, M.A. Scott, to B. Spezialetti, "Response to Action Item #2 of Conditions of Acceptance for the LAW PSAR Construction Authorization, ref: ORP/OSR-2002-18, Rev A dated 06/14/02," dated October 15, 2002.

thermal loads for the LAW facility structure remains conservative." The reviewers agreed with BNI's conclusions. Completion of this analysis satisfies a condition of acceptance in the SER for walls to grade construction authorization.

2. **Identifying Potential Accident/Event Sequences** – The reviewers found conditionally acceptable the identification of potential accident/event sequences as described in PSAR Chapter 3, Appendix A CSD records and Appendix B; and in 24590-WTP-RPT-TE-01-004. PSAR Sections 3.3.1, 3.3.2, and 3.3.3 described the identification of internal and external events. The reviewers evaluated this information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 2. The information satisfied the requirements in SRD Safety Criterion 3.2-1; the SRD, Appendix A, Section 4.2, "Identification of Potential Accident/Event Sequences"; and the ISMP, Section 1.3.6, "Accident Analysis."

The reviewers found that the PSAR (Chapter 3 and Appendixes A and B) and the referenced calculations (see Section 8.0), described (a) accident sequences that identified initiating events with their preventive and mitigative control strategies, (b) the rationale for sorting hazardous situations into accident groups or categories, and (c) the selection of comprehensive and credible accident sequences.

For internal events, the PSAR identified internal event sequences involving liquid spills or overflows from SSCs located in the facility. The PSAR also analyzed internal event sequences leading to molten glass spills on the basemat from the melter.

For external events, the PSAR identified two event sequences that could impact the LAW facility: (1) the seismic DBE and (2) the mis-feed event. The identification of the seismic event was found to be acceptable because the results were analyzed using a systematic and comprehensive approach that satisfied the requirements in SRD Safety Criterion 3.2-1 and the SRD, Appendix A, Section 4.2. The reviewers questioned the analysis of the mis-feed event presented in PSAR Section 3.2.2.2 and found it conditionally acceptable as discussed in Section 4.1.2.2, Item 1, of this SER.

The reviewers found the limited discussion of the evaluation of secondary events directly caused by external events (e.g., hazards from other facilities, aircraft crashes, pipeline ruptures, and truck crashes) to be acceptable because the reviewers concluded that the events did not affect the LAW facility design requirements.

For potential event sequences that could lead to unmitigated consequences of SL-1, -2, and -3 or above threshold chemical releases, the reviewers found that the PSAR acceptably described these potential event sequences (e.g., molten glass spill event, mis-feed event, and spill/overflow events from the LAW concentrate receipt vessel) to estimate the unmitigated consequences and frequencies.

In response to Question LAW-PCAR-020, BNI described the process used to bin the accidents to select DBEs. A combination of control strategy, consequence, and accident type was used to select accidents. The reviewers found that the binning approach described was comprehensive and complete as it related to the LAW facility.

SRD Safety Criterion 4.2-1 requires the facility to be designed to retain the radioactive and hazardous material through a conservatively designed confinement system for normal operations, anticipated occurrences, and accident conditions. The reviewers questioned (Question LAW-PSAR-036) whether flooding caused by the extended, uncontrolled release of liquids, such as from a break in a fire water line, could result in floor and wall loadings in excess of design limits. In response, BNI performed a detailed hazard topography of structural impacts from water loading due to potential spills or leaks based on current LAW design information. This evaluation was documented in calculation report 24590-LAW-U0C-30-00001, *Flooding Evaluation for the LAW Facility.* The calculation report identified several areas with the potential for water accumulation greater that the floor live load allowance (100 psf). BNI also committed to update the evaluation of LAW internal flooding as part of the common-cause/common-mode failure analysis during ISM Cycle III; identify control strategies for internal flooding events, as necessary, to prevent unacceptable impacts to the safety function of the structure; and to include this information in the first LAW PSAR revision following completion of the hazard assessment. In addition, BNI committed to revise the LAW PSAR in the first revision following authorization for full facility construction to include the interim information on internal flooding events from the response to Question LAW-PSAR-036.

The reviewers found this commitment acceptable for structural construction of the LAW facility but found that the required flooding event hazard evaluation was incomplete. Therefore, the reviewers recommend that the required flooding event hazard evaluation (for the preliminary design) be submitted to and approved by ORP before the start of construction of the nonstructural aspects of the design expected to be credited as SDC or SDS SSCs for the internal flooding event, on a schedule to be mutually agreed to, as required by the Contract, Standard 7(e)(2)(x), as a condition of approval of construction authorization. Because of the partial resolution of the flooding issue described above and previous walls to grade SER condition of approval on this same issue, LAW PSAR condition of acceptance (4) is superceded and closed.

The reviewers questioned the adequacy of evaluation of certain accidents involving flammable gas explosions, steam explosions (Question LAW-PSAR-064), and explosions involving ammonium nitrate (Question LAW-PSAR-113), identified in the PSAR Volume III, Appendix A records. SRD Safety Criterion 4.1-1 requires the prevention and mitigation of risks associated with radiological and chemical material inventories and energy sources. Two relevant records were CSD-LLMP/N0008, potential for a steam explosion from the instantaneous transfer of heat from molten sodium sulfate to water in the melter, and CSD-LLVP/N0003, potential for an explosion from deposition of ammonium nitrate in the offgas system, particularly in the offgas heat exchanger.

In response to Question LAW-PSAR-064, BNI described design features, including water drains and leak detection within the melter shell, that will mitigate the potential for a steam explosion outside the melting cavity. Other design features will prevent steam explosions by limiting the rate at which water can be introduced via the bubbler tubes into a postulated zone of molten sodium sulfate in the melter cavity. These features include maintaining air pressures higher than pressures in water lines to prevent backflow of water into the air system, using air drying systems, and minimizing the size of bubbler

orifices and bubbling pressures. In its response, BNI committed to include these design features in the first PSAR revision. BNI also committed that "the potential for water injection via wash water, or feed nozzle cooling water, will be evaluated and demonstrated to be bounded by the analysis in Topical Report, RPT-W375-SA-00001, *Waste Treatment Plant Explosive Evaluation*, Section 2, 'Steam Explosion'." The reviewers found the commitments to design features and additional evaluation acceptable. Finally, BNI committed that the first PSAR revision following authorization for full facility construction will include these design features, if any, and the results of the evaluation.

In response to Question LAW-PSAR-113, BNI stated that it had retained the services of an expert to address whether there are operation regimes in the offgas system propitious for formation and deposition of ammonium nitrate. BNI committed to implement appropriate control strategies as necessary based on this expert evaluation and to include the results of this evaluation in the next PSAR revision. The reviewers found this commitment acceptable because the likelihood that additional control strategies affecting the approved PSAR design would be necessary as a result was judged to be remote.

3. **Estimating Accident Consequences** – The reviewers found the estimate of accident consequences to be acceptable, as described in PSAR Chapter 3 and Appendix A CSD records; 24590-WTP-RPT-TE-01-004; and 24590-LAW-Z0C-W14T-00003, *Revised Severity Level Calculations for the LAW Facility.*

The reviewers found the PSAR estimates of unmitigated consequences for radiological and chemical hazardous situations in the LAW facility to be acceptable. The reviewers also found the mitigated consequences for the identified accident sequences and associated CSD records to be acceptable. The reviewers found these results satisfy the requirements of SRD Safety Criteria 3.1-3 and 3.1-4 and the SRD, Appendix A, Section 4.3, "Estimation of Consequences."

PSAR Sections 3.3.3 and 3.3.5 provided the results of the hazard analysis and DBE selection process used to determine the necessary unmitigated and mitigated consequence analysis for the potential accident/event sequences identified in the LAW facility. The reviewers evaluated this information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 3. The results are discussed below:

(a) **Unmitigated Consequences** – The PSAR provided estimates of the accident consequences. For the LAW facility, the PSAR identified, in the Appendix A CSD records, the potential radiological and chemical hazard consequences for facility and co-located workers and the public for radiological consequences above SL-4 and chemical consequences above threshold. The reviewers found the PSAR estimates of accident consequences to be adequate for hazard analysis.

For radiological consequences, PSAR Section 3.4.2 described two external events, the seismic event and the mis-feed event (inadvertent feed of HLW to the LAW facility feed receipt tanks). For the seismic DBE, calculation report 24590-LAW-Z0C-S30T-00001 provided the unmitigated and mitigated accident

consequences. The calculation estimated that the largest unmitigated radiological dose to the facility worker during a seismic event (5.1 rem) was below the radiological exposure standards limit for mitigated dose for an unlikely event (25 rem). The unmitigated inhalation doses for the co-located worker (<10.5 rem) and the public (<20 mrem) based on the failure of all vessels containing radioactive material were similarly well below the radiological exposure standards limits for a mitigated dose for an unlikely event (25 rem for the co-located worker and 5 rem for the public). The reviewers found these estimates and the methodology in 24590-LAW-Z0C-S30T-00001 to be acceptable because they were consistent with the SRD, Appendix D, "Radiological Exposure Standards for the RPP-WTP Project."

For the seismic event, BNI determined that the unmitigated radiological consequences from release of offgas and molten glass spills from three catastrophically failed melters would be 4.5 rem to the co-located worker and 1.42 x 10^{-2} rem to the public (24590-LAW-Z0C-S30T-00001). The unmitigated dose to the worker from offgas and glass spill from one catastrophically failed melter was estimated to be 1.07 x 10^{-2} rem. The reviewers found these estimates and the methodology in 24590-LAW-Z0C-S30T-00001 acceptable because they were consistent with the SRD, Appendix D.

For the mis-feed event where highly radioactive material could be transferred from the PT facility to the LAW facility, PCAR Section 3.4.2.2 stated that unmitigated area radiation levels could be as high as 100 mrem/hr. However, a revised analysis of this event was documented in the PSAR Section 3.4.2.2 and in the response to Question LAW-PCAR-098. BNI's response to the question and the PSAR identified that unmitigated consequences from a mis-feed event could result in exposures to the facility worker of >25 rem, an SL-1 event. The scenario assumed that the waste envelope B/D was inadvertently transferred from PT to LAW while a facility worker was in the wet process cell. The reviewers found the revised analysis acceptable because it more appropriately represented the accident scenario.

PSAR Section 3.3.5 estimated that unmitigated chemical releases from a loss of the offgas system event (CSD-L720/0001 or CSD-LLOP/N0006) could lead to chemical consequences above thresholds of SRD Safety Criterion 2.0-2. The reviewers found the estimation of these consequences acceptable because the methodology was consistent with the SRD, Appendix A, "Implementing Standard for Safety Standards and Requirements Identification."

(b) **Mitigated Accident Consequences** – For the seismic event, calculation report 24590-LAW-Z0C-S30T-00001 was performed to determine the appropriate seismic classification of the LAW facility, which was SC-III on the basis of chemical consequences using SRD Safety Criterion 4.1- 4. Accordingly, the expected damage to the facility from a seismic DBE is relatively minor structural damage. As stated in DOE-STD-1020-94, Appendix B, "Commentary on General NPH Design and Evaluation Criteria," the damage to a PC-2 (SC-III) facility from

a seismic DBE is damage that minimally interrupts operations and can be easily and readily repaired following the event. Analysis of the seismic DBE for the LAW facility resulted in estimated radiological and chemical consequences below the corresponding SRD standards in Safety Criteria 2.0-1 and 2.0-2. The reviewers found the seismic analysis to be appropriate and the associated facility seismic performance to be acceptable.

The molten glass spill had no mitigated consequences because the safety function of the LAW facility was shown to be unaffected by the molten glass spill, as analyzed in CCN: 042912.[101]

For the mis-feed event, if the preventive control strategies were to fail, the mitigated exposure to the facility worker would be several hundred mrem, well below the radiation exposure standards of SRD Safety Criterion 2.0-1 for all frequency ranges.

For the liquid spill/overflow event, the PSAR stated that there were no mitigated consequences because of the administrative controls to be implemented to prevent the event. The SRD, Appendix B, "Implementing Standards for Defense in Depth," has the provision that "administrative controls alone *may* be credited as the controls that protect facility workers, when appropriate." In Questions LAW-PSAR-070 and -072, reviewers asked for the rationale as to why it was appropriate to use administrative rather than engineered controls for the liquid spill/overflow event. BNI responded that controls were adequate to prevent this event because (1) although access is permitted in the wet process cell that contains the concentrate receipt vessel, no personnel access is allowed when the concentrate receipt vessel contains LAW concentrate; (2) access would be permitted only after draining and flushing the vessels to reduce the radiation levels to those low enough for personnel access; and (3) personnel access to the wet process cell will be controlled by a locked (key) door based on radiation protection program requirements.

The reviewers noted that this event was just severe enough to be in the SL-2 category and the committed administrative controls were robust and commensurate with the limited hazard. The reviewers concluded that using only the proposed administrative controls was acceptable to prevent a dose to a facility worker for the liquid spill/overflow event.

The PSAR stated that the loss of offgas system function (CSD-L720/0001 or CSD-LLOP/N0006) was considered incredible due to the design of the offgas system to meet the single-failure criterion as defined in SRD Safety Criterion 4.3-2. Therefore, the mitigated consequences for this event were zero. The reviewers agreed with this rationale.

[101] CCN: 042912, BNI internal memo, M.A. Scott, to B. Spezialetti, "Response to Action Item #2 of Conditions of Acceptance for the LAW PSAR Construction Authorization, ref: ORP/OSR-2002-18, Rev A dated 06/14/02," dated October 15, 2002.

4. **Estimating Accident Frequencies** – The reviewers found the information on estimating accident frequencies to be acceptable. PSAR Appendix A CSD records contained acceptable estimates of the frequency of accident initiators. The estimation of accident frequencies relevant to the LAW facility was documented in PSAR Chapter 3 and Appendix A CSD records and in the hazard analysis in 24590-WTP-RPT-TE-01-004. These frequency determinations were based on methodology described in 24590-WTP-GPP-SANA-002. The reviewers evaluated this information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 4, as discussed below.

   The estimates of initiating event frequencies in CSD records and mitigated accident frequencies were provided in DBE calculation reports, 24590-LAW-Z0C-W14T-0003 and 24590-LAW-Z0C-S30T-00001. The reviewers evaluated the CSD records for initiating event frequencies and assessed PSAR Section 3.3.3, which indicated that radiological and chemical events were conservatively assigned an initiating event frequency that placed them in the unlikely event frequency bin unless the event initiator was an earthquake. The highest frequency of this unlikely event range, 0.01 events per year, was selected consistent with the highest failure rate for process vessels and piping recommended by 24590-WTP-GPG-SANA-002. The reviewers found these values to be acceptable because they were consistent with data from other industrial sources, such as AIChE *Guidelines for Process Equipment Reliability Data, with Data Tables,* and represented the mean value from these data sources.

   PSAR Section 3.4.2 described two external events and their estimated event frequencies: the seismic DBE and the mis-feed event. For the seismic DBE, the annual probability of occurrence of the SC-III design basis earthquake was 10^{-3}. In responses to Questions LAW-PCAR-098 and LAW-PSAR-56, BNI stated that for the mis-feed event, the estimated probability of occurrence for a "significant exposure" was $<10^{-6}$ per year based on several independent controls (in the PT facility) that prevent the mis-feed event (e.g., gamma monitors and associated interlocks, administrative controls for valve and jumper line-up, and vessel sampling). While BNI did not provide an explicit basis for the estimated probability of occurrence or the level of exposure considered "significant," the reviewers agreed with the estimate and therefore concluded that controls committed to be provided in the PT facility, in conjunction with the radiological shielding provided by the LAW facility process cell walls, were acceptable.

   PSAR Appendix A identified numerous initiators leading to a molten glass spill event, with estimated frequencies of 10^{-2}/year. This is consistent with the operational risk assessment, 24590-WTP-U7C-50-00001, *WTP Risk Analysis – Risk Goal Confirmation, Volumes 1-5,* where the potential failure rates of glass melter shells and other similar vessels were estimated to be 10^{-3} to 10^{-2}/year. The estimated frequency of failure of the administrative controls for the liquid spill event (CSD-LLCP/N0002) discussed above was 5×10^{-3}/yr. The reviewers found these estimates to be acceptable.

5. **Considering Common-Cause and Common-Mode Failures –** The reviewers found conditionally acceptable the consideration of common-cause and common-mode failures as described in PSAR Section 3.3.4 and Appendix A CSD records, the hazard analysis in 24590-WTP-RPT-TE-01-004, and referenced DBE calculations. The reviewers

evaluated the information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 5. Credible common-cause events that could affect the LAW facility included natural phenomena events, external man-made events, loss of electrical power, fire, internal missiles, and internal flooding.

PSAR Section 3.3.4 described three broad categories of dependencies used to classify and define the important common-cause failures. The PSAR addressed two of these, functional dependencies and spatial dependencies. Functional dependencies reflected the reliance of multiple systems, trains, or components on a single system, train, component, or process condition. Spatial dependencies determined the impact of failure of components as a result of their co-location in an area that experiences the effect of an event such as explosion, flood, fire, seismic, or other natural forces and environmental stressors (e.g., extreme weather). Consideration of the third category, institutional dependencies, was deferred until a later PSAR submittal when the plant maintenance, operations, and procurement activities become more developed. The reviewers agreed that deferring consideration of institutional dependencies to a later PSAR revision was acceptable because these dependencies can be addressed in the programmatic development of the maintenance, operations, and procurement programs.

PSAR Appendix A documented the results of hazard analysis, including common-mode and common-cause failures due to spatial and functional dependencies. This analysis included hazards associated with the potential for human error and external events that could initiate credible common-mode failures. The records also considered and identified credible common-mode failures from failures of dependent subsystems (functional dependencies) and from failures of SSCs whose functional capabilities the systems depend on (i.e. electrical power) through dependent failure modeling.

Spatial dependencies for seismic DBE were adequately considered by assuming that all SC-III and -IV SSCs will fail. The reviewers found this approach to be acceptable because it bounded common-cause failures from a seismic DBE.

As part of the spatial and functional dependencies evaluation, the PCAR stated that the basemat's passive safety function was not impacted by internal events such as fires or flooding. The reviewers found this approach acceptable for the basemat because of the facility's low combustible loadings. However, for internal flooding, the reviewers found that structural loads to the basemat from internal flooding had not been considered. The reviewers concluded that internal flood loads, if any, would not sufficiently impact the basemat to prevent it from performing its intended safety function (i.e., structural support to the offgas system, associated piping, and the stack). The LAW basemat was not expected to be impacted because it is five feet thick and the interior walls are less than four feet thick. The reviewers concluded that the maximum moment due to flooding that can be transferred from the wall is not expected to exceed the basemat's capacity.

The reviewers identified a concern regarding the potential for flooding in above basemat/grade process cells because of a fire water line break or leaks from other sources, such as tanks and feed lines, and consequential floor and walls to grade loadings that could be in excess of design limits. In response to Question LAW-PSAR-036, BNI

committed to perform a hazard assessment to identify flooding hazards and to provide control strategies to prevent or mitigate flooding to avoid impacting the LAW facility structural design referenced in the PSAR. Reviewers found this response conditionally acceptable. This condition of acceptance was addressed previously in Section 4.1.2.2, Item 2, of this SER.

For functional dependencies, the reviewers considered potential common-cause failures due to loss of electrical power that might affect LAW facility safety function. The reviewers noted that the LAW facility structures do not depend on any ITS SSCs, other than themselves, to provide their safety function – which is to provide structural support for the offgas system and other ITS SSCs. The reviewers therefore concluded that loss of electrical power is not a common-cause failure concern for the LAW facility structure. The reviewers considered the effect of loss of electrical power on other ITS SSCs in the LAW facility. In particular, the reviewers questioned the ability of the melter offgas system to perform its safety functions in the event of a loss of offsite power. In response to Question LAW-PSAR-029, BNI stated that melter offgas exhausters and associated control systems were supplied power by three separate uninterruptible power system (UPS) units. Each UPS unit was sized to power the exhauster for 45 minutes. BNI's response to Question LAW-PSAR-029 also stated, and committed to include in the first PSAR revision, that approximately 30 minutes after being on UPS power, the plant would be evacuated, therefore eliminating the need for exhauster fans to protect the facility workers from NO_x release in the LAW facility. The reviewers found this commitment to be acceptable because the safety function of the offgas system is maintained for the duration required to protect the worker.

6. **Defining DBEs** – The reviewers evaluated both internal and external DBEs affecting the LAW facility and found them to be conditionally acceptable:

   (a) **Internal DBEs** – The reviewers found BNI's selection of internal DBEs to be acceptable. The PSAR defined the bounding hazard control strategies for the LAW facility. Based on the DBE selection analysis in PSAR Sections 3.3 and 3.4 and Appendix A and in 24590-WTP-RPT-TE-01-004, BNI concluded that only one internal DBE was relevant to the LAW facility: offgas release of NO_x from the melter into LAW facility or into the environment. The NO_x release would result from the loss of structural capability of the facility, to the extent that the offgas system, piping, or stack lost their integrity or unimpeded flow capability. The PSAR stated that the design basis offgas release event was initiated by a design basis (external) seismic event.

   PSAR Section 3.4.1.2 evaluated an internal fire inside the LAW facility as a potential DBE and concluded that the consequences of this event would be bounded by the consequences of the DBE for loss of offgas system. The fire hazards associated with the LAW facility were assessed as part of the PFHA, and details of this evaluation are provided in Section 3.18 of this SER.

   The reviewers questioned the impact of a molten glass spill event and its impact on the LAW facility structural capability (Questions LAW-PCAR-039, -040, -43,

-052, -055, -84, and -88 and LAW-PSAR-135). BNI performed unmitigated analyses of the thermal impact of the hot molten glass spilling onto the concrete basemat floor to determine its potential damage to the LAW facility and whether such an event would affect the LAW facility's ability to perform its intended safety function. BNI performed thermal and structural analyses (CCN: 042912[102]) to address these impacts and modified the structural design accordingly. These calculations were reviewed and found to be acceptable for the LAW facility based on the inputs, assumptions, and methodology used. (See also the discussion in Item 1, Section 4.1.2.2.)

(b) **External DBEs** – The reviewers found the selection and analysis of external DBEs that affect the LAW facility (PSAR Section 2.4.2) to be conditionally acceptable according to the acceptance criteria in RL/REG-99-05, Section 4.6.3. Based on the DBE selection analysis (24590-WTP-RPT-TE-01-004), BNI concluded that only two external DBEs could potentially affect the LAW facility: the seismic DBE and the mis-feed event.

For seismic and other external DBEs, the reviewers evaluated calculations, design information in the PSAR, and the responses to Questions LAW-PCAR-066 to -077, -079 to -089, and -091 to -097 concerning basemat design and analysis, including interfacing walls to grade that transfer vertical loads to the basemat.

The reviewers also evaluated this information for other external facility phenomena and events (e.g., wind, missiles due to wind, flooding, volcanic ash, and snow and mis-feed). The reviewers found the information to be conditionally acceptable per the eight information areas identified in RL/REG-99-05, Section 4.6.3.3.1, for seismic DBEs. Evaluation of the information for the seismic DBEs for each of the eight information areas is summarized below:

(i) The reviewers found the identification of the LAW facility structure as SC-III and PC-2 to be acceptable because it was consistent with SRD Safety Criterion 4.1-4 requirements.

(ii) The reviewers found the seismic hazard curve and response spectra for PC-2 and the LAW facility to be acceptable because they were consistent with SRD Safety Criterion 4.1-4 and DOE-STD-1020-94 requirements.

(iii) The reviewers found the seismic analysis methods, presented in the PSAR Volume I for SC-III LAW building and structural components, to be acceptable. The reinforced concrete structures will be designed to ACI 318-99 and the steel structures will be designed to AISC M-016-89, *ASD Manual of Steel Construction*. As part of the PCAR basemat and walls to grade review, designs and calculations of the basemat and wall to

[102] CCN: 042912, BNI internal memo, M.A. Scott, to B. Spezialetti, "Response to Action Item #2 of Conditions of Acceptance for the LAW PSAR Construction Authorization, ref: ORP/OSR-2002-18, Rev A dated 06/14/02," dated October 15, 2002.

grade were found acceptable because they are consistent with ACI 318-99 (required by Safety Criterion 4.1-4).

While a complete review of the remaining above-grade concrete structures and the steel superstructure design could not be conducted because BNI's design had not been completed, BNI's design criteria were reviewed. The reviewers found design codes and standards for the seismic category (SC) SC-III LAW building to be acceptable as presented in 24590-WTP-DC-ST-01-001. These criteria, developed for WTP facilities, provided the minimum structural design criteria for each seismic category building. The criteria ensure that building structures were designed to withstand the effects of natural phenomena events postulated to occur during the life of the building. The criteria also describe the natural phenomena events selected, the rationale for their selection, and the bases for the design and evaluation of ITS SSCs. Chapter 6 of 24590-WTP-DC-ST-01-001 detailed the SC-III and -IV building requirements for reinforced concrete, structural steel design, and masonry design. Load factors, load combinations, stability requirements, deflection, anchorage, and story drift requirements were established. The reviewers found 24590-WTP-DC-ST-01-001 acceptable because it was consistent with the SRD Safety Criterion 4.1-4 and the implementing standard DOE-STD-1020-94.

(iv) The reviewers evaluated the seismic analysis calculation report 24590-LAW-Z0C-S30T-00001, including models, methods, element seismic demands, factored and combined total element structural demands and comparison to reinforced concrete element structural capacities, rebar design details, and design margins for structural design adequacy. The reviewers found the interpretation of acceptance criteria to be acceptable, including the process to compare the calculated seismic and total demands with the corresponding capacities. The reviewers found the seismic design analyses to be acceptable because they were consistent with SRD Safety Criterion 4.1-4 and the implementing code ACI 318-99 and DOE-STD-1020-94 requirements.

(v) The reviewers found the detailing requirements for anchoring the reinforcement bars in the reinforced concrete design of the LAW SC-III facility structure to be acceptable. The detailing requirements were consistent with the ACI 318-99 concrete code, the Portland Cement Association standard PCA EB 080, and DOE-STD-1020-94 as required by SRD Safety Criterion 4.1-4.

(vi) DOE-STD-1020-94 does not require analysis of beyond-design-basis earthquake seismic events for PC-2 structures. (The LAW facility meets PC-2 structural requirements [SC-III]). However, beyond-design-basis seismic events were considered in evaluating the seismic probabilistic risk analysis that was performed for the LAW facility. Section 4.6 of this SER

provides the evaluation of the seismic probabilistic risk analysis that was performed for the LAW facility.

(vii) The reviewers found the methods for calculating the seismic loads and designing the basemat and walls to grade for these and other loads to be acceptable for application to the full LAW building because the methods were consistent with the requirements of DOE-STD-1020-94; ASCE 4-98, *Seismic Analysis of Safety-Related Nuclear Structures and Commentary*; and SRD Safety Criterion 4.1-3.

(viii) The reviewers found the safety functions and the operability of each feature required for seismic safety regarding the LAW facility design to be acceptable. The reviewers questioned what the ventilation confinement requirements were for the LAW facility, if any (Question LAW-PCAR-002). BNI responded that no limits for structural cracking were established because no confinement requirements were identified in the hazards and accident analysis and that concrete cracking is limited to the implementing ACI 318-99 code requirements for normal operating and seismic conditions to ensure support of the SDC exhaust stack and melter offgas system. The reviewers accepted this clarification.

For other external DBEs, the reviewers evaluated design information in the general and facility-specific sections (PSAR Sections 2.4.3.4, 2.4.3.5, 2.4.3.6, and 2.4.3.13), associated analyses, and the responses to questions concerning the LAW facility design and analysis for other external facility phenomena and events (e.g., snow, volcanic ash, wind, missiles due to wind, transportation, flooding, and mis-feed). The reviewers found the information provided for the six information areas identified in RL/REG-99-05, Section 4.6.3.3.2, to be acceptable. The evaluation of the information for each area is summarized below:

(i) The reviewers found the wind loads that were quantified in calculation reports 24590-LAW-S0C-S15T-00005 and 24590-LAW-DBC-S13T-00011 to be acceptable. These analyses document that the facility's design satisfies the SRD Table 4.1-2 requirements for wind loads.

(ii) The reviewers found the PSAR Section 2.4.3.6 statement that indicated that missiles due to wind are not applicable to the LAW building as an SC-III structure per SRD Safety Criterion 4.1-4 to be acceptable because it was also consistent with the SRD, Table 4.1-2, and with the implementing DOE-STD-1020-94 for PC-2 structures.

(iii) No external flooding was considered for the LAW facility. The reviewers found this acceptable because, as stated in PSAR Volume I, Section 1.4.2.1, the LAW facility is more than 150 feet above the maximum postulated flood level.

(iv) The PSAR used design criteria for roof loads due to volcanic ash per Ashfall Load A of DOE-STD-1020-94 PC-2 criteria required by the SRD Safety Criterion 4.1-4. Ash loading was considered concurrent with roof live loading as described and quantified in calculation report 24590-LAW-S0C-S15T-00006. This analysis showed that the facility meets the applicable design requirements for withstanding loading due to volcanic ash. The reviewers found this analysis to be acceptable.

(v) The PSAR used roof snow loads, including snowdrift based on a ground snow load of 15 psf per the PSAR, Section 2.4.3.4. This snow loading was considered concurrent with roof live loading as described and quantified in 24590-LAW-S0C-S15T-00006. This analysis showed that the facility's preliminary design will meet the applicable requirements of SRD Safety Criterion 4.1-4 for withstanding loading due to snow. The reviewers found the analysis to be acceptable.

(vi) The accidental impact of aircraft onto LAW buildings was evaluated in calculation report 24590-WTP-Z0C-50-00001. The reviewers found conditionally acceptable BNI's evaluation of accidental impact of aircraft onto LAW. The reviewers' evaluation for this event is described in Section 4.1.1.2 under Facility Description, Item 4(f), in this SER. For other man-made external events, see Section 4.2.2.2, Item 6(c)(vi) in this SER.

The reviewers also found the calculation methods and software used in these non-seismic external DBE evaluations to be acceptable and consistent with their applications.

As discussed above, the mis-feed event is also an external DBE. This event was also discussed in Section 4.1.2.1, Item 1, in this SER. The reviewers determined that the PSAR adequately addressed the occurrence of this event by selecting suitable controls in the PT and LAW facilities to mitigate the event if it were to occur. The controls at the PT facility to prevent the mis-feed event include (1) a gamma monitor with interlocks to stop the transfer, (2) administrative controls for properly aligning valves and jumpers, and (3) administrative controls requiring sampling of vessels at the PT facility. The controls at the LAW facility include (1) administrative controls requiring sampling of the feed at the feed receipt tank and (2) administrative controls to prevent entry into the wet process cell area when LAW feed is present in the feed receipt tanks. The gamma monitor, related circuitry, and the administrative controls will be covered by TSRs.

7. **Defining the Operating Environment** – The reviewers found the definition of operating environments and performance requirements to be acceptable. In accordance with requirements in the SRD, Appendix A, Section 4.7, "Definition of Operating Environment," the PSAR identified a set of bounding operating conditions and performance requirements of the LAW facility. The bounding operating environmental requirements considered temperature, radiation levels, and chemical environmental

requirements. The PSAR did not identify any special operating conditions for the LAW facility ITS SSCs related to pressure, humidity, and radiation levels associated with the performance of its safety function. The only operating environments and performance requirements for the LAW basemat and concrete walls were associated with temperature in the pour cave area during normal operations and from the molten glass spill event during accident conditions. The reviewers found the definition of operating environments and performance requirements for the LAW facility to be acceptable based on using bounding thermal conditions during normal and accident conditions.

8. **Identifying Potential Control Strategies** – The reviewers found the identification of potential control strategies and documentation of required information for each ITS SSC to be conditionally acceptable. Information on potential control strategies was provided in PSAR Volume III, Sections 3.3, 3.4, and 4.4 and Appendix A CSD records, including control strategy elements and safety case requirements identified in the CSD records; and in DBE calculation report 24590-LAW-Z0C-S30T-00001. This information identified the potential control strategies associated with hazards, accident situations, and DBEs (e.g., seismic DBE, mis-feed event and the molten glass spill event). PSAR Chapter 4 provided information for each ITS SSC using the format defined in Section 4.5.3.3.3 of RL/REG-99-05, and Chapter 3 listed risk reduction class (RRC) SSCs with their associated safety functions.

The PSAR stated that the unmitigated doses to the public and the co-located worker were well below the dose standards for all internal radiological DBEs; therefore, no control strategies were required for further mitigation. The highest calculated dose for a maximum radiological spill was 5 rem to a facility worker with an estimated event frequency of 0.01 events per year, based on calculation report 24590-LAW-Z0C-W14T-00003, *Revised Severity Level Calculations for the LAW Facility.* For the co-located worker and the public, the doses were 6.4×10^{-1} and 4.6×10^{-4} rem, respectively. Therefore, to protect the facility workers, administrative controls were considered adequate given the low unmitigated doses and conservatively estimated initiating event frequencies. The reviewers found the use of administrative controls as the control strategy for protecting the facility worker for this event to be acceptable because this use was consistent with the SRD, Appendix B, "Implementing Standards for Defense in Depth." (See also the earlier discussion in Section 4.1.2.1, Item 3[b] of this SER.)

The PSAR identified only two external DBEs that imposed any control strategies on the LAW structure: (1) seismic DBE and (2) the mis-feed event. For the seismic DBE, the PSAR identified control strategies associated with the passive nature of the structure's safety function. The facility structure, including the LAW facility, could, if it failed or malfunctioned, adversely affect the function of the SDC melter offgas system by causing the melter offgas system to become blocked. Therefore, the PSAR stated that the facility would be designed to meet SRD Safety Criterion 4.1-3, which requires SDS SSCs that solely have a chemical safety function to be categorized SC-III because such SSCs protect facility workers, co-located workers, and the public from exposure to NO_x. The reviewers found the control strategies for the seismic DBE to be acceptable.

The reviewers found the control strategies for the mis-feed event to be conditionally acceptable. For the mis-feed event, in responses to Questions LAW-PCAR-098 and LAW-PSAR-056, BNI stated that administrative controls would be implemented for sampling and verification programs to ensure that only in-specification feed was placed in the treated concentrate process tank in the PT facility. Valve and jumper line-ups will be verified before any material is transferred directly to the LAW facility. All material transferred to the LAW facility must pass through a gamma monitor and associated interlocks before leaving the PT facility. Interlocks will prevent transfer if a high gamma level is detected. The SDS LAW wet process cell shield walls were also identified as a control to mitigate the consequences should a mis-feed occur. The operability of the gamma monitor, related circuitry, and the required administrative controls will be ensured by TSRs. The single-failure criterion of the SRD, Appendix B, Section 3, "Determination of SSCs for the Implementation of Defense in Depth," was satisfied by the gamma monitor with interlocks at the PT facility and the shield walls and associated access controls for the LAW facility wet process cell. BNI committed in its responses to Questions LAW-PCAR-098 and LAW-PSAR-056 that it would include in the first PSAR revision, the control strategy described above for the mis-feed event. The reviewers found the commitment to be acceptable.

The only SDC system in the LAW facility is the melter offgas system; the SDC classification is based solely on chemical hazards from NO_x. The control strategy to protect the worker from this hazard is prevention of release of NO_x into the facility. As discussed in PSAR Section 3.4.1.1, the specific SSCs credited in the control strategies for melter offgas hazard include the melter offgas system exhausters, offgas system piping, certain offgas system components, and the exhaust stack. Three separate exhausters provide motive force to pull offgas from the melter plenums and push it through the secondary offgas system components. One exhauster is sufficient to maintain the safety function of the offgas system. Offgas system controls are configured such that at least one exhauster unit is continuously providing motive force to the system. UPS power systems are provided to serve the system exhausters. The offgas system components must reliably contain the gases and maintain an open flow path for the exhaust of the offgas to the stack. PSAR Sections 3.4.1.1.2.6, 4.3 and 4.4, respectively, summarize the functional requirements, performance requirements, and bounding environmental conditions for ITS SSCs related to the offgas system. The reviewers found the control strategies for the melter offgas hazard to be acceptable except as discussed in the next paragraph.

The reviewers questioned the offgas system's ability to control the NO_x hazard under bounding transient conditions. In responses to Questions LAW-PSAR-044 and -077, BNI committed that additional melter and melter-offgas testing and dynamic simulated modeling of the melter offgas will be performed to establish operating ranges for the melters and the unit operations in the offgas system and that the results of this testing and simulated modeling would demonstrate how workers are protected against releases of NO_x and hot melter offgases under fully integrated equipment operating ranges and under bounding transient offgas conditions. The reviewers found this commitment acceptable.

The reviewers identified an additional safety function for the LAW facility structure that was not identified in the PSAR. The PSAR identifies the seismic DBE event as SL-2 for the facility and co-located worker, the mis-feed event as SL-1 for the facility worker, and the liquid spill/overflow from the LAW concentrate receipt vessel as SL-2 for the facility worker. The SRD, Appendix B, Table 1, requires two or more independent physical barriers for an SL-1 hazardous condition and consideration of two or more physical barriers for an SL-2 hazardous situation. In all of these hazardous situations, portions of the LAW facility structure form part of the second physical barrier required by SRD Table B3-1. This safety function of the LAW facility structure is not currently reflected in the PSAR. However, the PSAR deficiency does not affect the designation of the LAW facility structure as an SDS SSC because none of these hazardous situations with missing physical barrier safety functions result in mitigated accident consequences approaching the radiological exposure standards of SRD Safety Criterion 2.0-1. The seismic category of the LAW facility remains SC-III according to the SRD, Appendix B, and SRD Safety Criterion 4.1-4. In the authorization agreement for walls to grade construction, BNI agreed to revise the PSAR to include the additional safety functions for the LAW facility structure in the first PSAR revision following authorization for full facility construction to correct this deficiency. The reviewers found this commitment acceptable.

9. **Documenting the Hazard Evaluation** – The reviewers found the documentation of the hazards evaluation and accident analysis, as presented in PSAR Chapter 3 and Appendix A CSD records and in 24590-WTP-RPT-TE-01-004, to be acceptable except as noted in the preceding parts and conditions of acceptance stated in this SER Section 4.1.2.2 of this SER.

   Uncertainties in models (e.g., input assumptions, boundary conditions, and modeling techniques), data, and phenomenology used in estimating accident consequences and frequencies were described in the calculations for DBEs. In the analysis of the DBEs, these calculations also identified other uncertainties and assumptions important to the results of the calculation. The reviewers evaluated these descriptions in the DBE calculations and found them to be acceptable, given the preliminary status of design and associated flowsheets.

4.1.2.3 Conclusions

The reviewers concluded that the results of LAW facility hazard and accident analysis for the preliminary level of design were conditionally acceptable. The reviewers also concluded that the hazards information, as supplemented by information in responses to the reviewer questions and in referenced calculations (see Section 8.0), was consistent with the preliminary design of the facility and process design. The reviewers found that the radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, were adequately assessed and that sufficient control or mitigation features were identified. The PSAR, along with its referenced calculations and documentation and the formal responses to reviewer questions, adequately documented the safety basis for the construction of the LAW facility.

LAW Facility Hazard and Accident Analysis – Two conditions of acceptance originally identified in Section 4.1.2, "LAW Facility Hazard and Accident Analysis," in Revision 1 of the SER, were completed:

1. Revise the design calculation report 24590-LAW-DBC-S13T-00005, *Thermal Analysis for Basemat and Pour Cave Walls*, to incorporate the results of the computational fluid dynamics analysis of the pour cave. The analysis must confirm that the concrete temperatures of the melter and pour caves could be maintained within design limits during the postulated glass spill and loss of cooling accident scenario. All structural calculations affected by the computational fluid dynamics analysis must be revised, as appropriate. These should be completed before authorization for full LAW facility construction. (COMPLETE) (See Section 4.1.2.2, Item 8.)

2. Complete hazard and accident analysis of internal flooding, including identification of control strategies required to protect the safety functions of the facility structure, assuming PSAR reference structural design, before the start of full LAW facility construction. (COMPLETE, is superceded by conditions of acceptance [3] and [5] below.) (See Section 4.1.2.2, Item 2.)

Conditions of Acceptance – BNI must complete the following actions, except for Item 5 below, with the first PSAR revision following authorization for full facility construction:

1. Correct the discrepancies related to the CSD records identification system used in SIPD and as referenced in the LAW and HLW PSAR texts and tables, as committed to in responses to Questions LAW-PSAR-069 and -169, and as agreed to in the authorization for construction for walls to grade. (See Section 4.1.2.2, Item 1.)

2. Include the analysis related to the mis-feed hazardous situation, identifying control strategies that include the provision of gamma monitor activated automatic valve closure as SDC SSCs in the PT facility to prevent the mis-feed to the LAW facility and to designate certain LAW process cell shield walls as SDS SSCs to mitigate the event, as committed to in responses to Questions LAW-PCAR-098 and LAW-PSAR-056. (See Section 4.1.2.2, Item 1.)

3. Include interim information on internal flooding events, as committed to in response to Question LAW-PSAR-036. (See Section 4.1.2.2, Item 2.)

4. Include the design features for mitigating the potential for steam explosion in the LAW melter and the results of the evaluation of the potential for water injection via wash water or feed nozzle cooling water, as committed to in response to Question LAW-PSAR-064. (See Section 4.1.2.2, Item 2.)

5. Submit the internal flooding event hazard evaluation (for the preliminary design) to ORP for approval, and receive DOE approval, before start of construction of the nonstructural aspects of the LAW design expected to be credited as SDC or SDS SSCs for the internal flooding event, on a schedule mutually agreed to by ORP and BNI. (See Section 4.1.2.2, Item 2.)

6. Include the results of the offgas system evaluation for ammonium nitrate deposition potential, including what control strategies, if any, will be implemented to address concerns identified through this evaluation, as committed to in response to Question LAW-PSAR-113. (See Section 4.1.2.2, Item 2.)

7. Include that approximately 30 minutes after being on UPS system power, the plant would be evacuated, therefore eliminating the need for exhauster fans to protect the facility workers from NO_x release in the LAW facility, as committed to in response to Question LAW-PSAR-029. (See Section 4.1.2.2, Item 5.)

8. Correct the omission of additional safety functions for the basemat based on the seismic DBE event being SL-2 for the facility and co-located worker, the mis-feed event being SL-1 for the facility worker, and the liquid spill/overflow from the LAW concentrate receipt vessel being SL-2 for the facility worker, as agreed to in the authorization agreement for walls to grade construction. (See Section 4.1.2.2, Item 8.)

4.1.3 LAW Facility Important-to-Safety SSCs

The purpose of this review was to determine whether the PSAR adequately identified the LAW facility ITS SSCs and the environmental conditions under which they must function.

4.1.3.1 Requirements

The PSAR must identify LAW facility ITS SSCs, using the format described in Section 3.4.1[103] of this SER, and address the following six elements, which are repeated for each ITS SSC: (1) SSC identification, (2) safety function, (3) system description, (4) functional requirements, (5) system evaluation, and (6) controls (TSRs). This section addresses the first five elements. Information on the review of the sixth element (i.e., TSRs) is contained in Section 4.1.4 of this SER.

The PSAR must also identify the most severe environmental conditions under which ITS SSCs in the LAW facility must function, including temperature, pressure, humidity, radiation level, and chemical environment.[104] The hazard control strategies selected must be shown to be consistent with the most severe environmental conditions identified. The operating environment during normal operations and under off-normal and accident conditions, as it affects the LAW facility ITS SSCs, must be considered.

4.1.3.2 Evaluation

Reviewers found the identification of ITS SSCs and associated safety functions, system descriptions, functional requirements, and systems evaluations to be conditionally acceptable.

[103] RL/REG-99-05, Section 4.5.3.3.3, "Regulatory Acceptance Criteria."
[104] SRD, Appendix A, Section 4.7, "Definition of Operating Environment."

The reviewers found that the ITS SSCs of the LAW facility would acceptably perform their safety functions under all normal, off-normal, and accident environmental conditions. The reviewers noted that the only instance in which environmental conditions might prevent an ITS SSC from performing its safety function is the molten glass spill accident in a melter cell. In this instance, the molten glass elevates the temperature of the SDS structure (basemat and walls), potentially threatening its ability to perform its safety function (support the SDC melter offgas system and the ventilation stack). The reviewers found that the basemat and walls could withstand the thermal loads associated with the spill while continuing to perform their safety function.[105]

Reviewers evaluated the adequacy of identification of ITS SSCs and associated performance requirements. The LAW PSAR included three designations for ITS SSCs: SDC, SDS, and RRC. The concept of RRC as a subset of ITS items was presented, concurrently with the PSAR, in 24590-WTP-ABCN-ESH-01-029, *Addition of Risk Reduction Class (RRC) Items to SRD*, Revision 0, and was revised to address reviewer concerns in Revision 1. In Revision 1, BNI defined RRC SSCs as all ITS SSCs that were neither SDC nor SDS. BNI also proposed that the implementing standards for performance requirements on RRC SSCs will be further identified by applying the SRD, Appendix A, "Implementing Standard for Safety Standards and Requirements Identification."

The PSAR was reviewed for the identification, safety function, system description, functional requirements, and system evaluation of the ITS SSCs. This review included evaluation of ITS SSCs designated SDC, SDS and RRC. Evaluation of the information on ITS SSCs for each element is provided below. The reviewers found the description of three of the five elements addressed here to be acceptable and two to be conditionally acceptable. The information related to TSRs is evaluated in Section 4.1.4 in this SER.

1. **SSC Identification** – The reviewers found the identification of SSCs designated SDC and SDS to be acceptable, as described in PSAR Volume III, Chapter 4. The SSCs designated SDC were as follows:

   - Exhaust stack offgas piping
   - Melter shell
   - Melter offgas system (the LAW primary offgas process system and the LAW secondary offgas/vessel process system).

   By examining the DBEs described in the PSAR and the hazard and accident analysis results related to those DBEs, the reviewers found all SDC SSCs and their safety functions were adequately defined and described. In addition, the system description for the hazard controls, their functional requirements, the applicable codes and standards, and operational controls (TSRs) combined to adequately control the hazards.

[105] Section 4.1.1.2, Item 9, of this SER.

The SSCs designated SDS were as follows:

- LAW structure
- Melter offgas system
- Submerged bed scrubber level instrumentation
- Wet electrostatic precipitator control instrumentation
- Selective catalytic reducer temperature interlock
- Melter plenum pressure interlocks
- Caustic scrubber.

The reviewers concluded that the identification of SDS SSCs was conditionally acceptable. By examining the DBEs described in the PSAR and the hazard and accident analysis results related to those DBEs, the reviewers found that all SDS SSCs and their safety functions were adequately defined and described, with one exception. The PSAR did not identify the ITS radiological shielding function for certain process cell walls as required to mitigate mis-feed of HLW to the LAW facility. Section 4.1.2.2, Item 1, in this SER discusses this event and the related condition of acceptance in more detail. The system description for the hazard control, their functional requirements, the applicable codes and standards, and controls (TSRs) all adequately controlled the hazards. The reviewers found the commitment described in Section 4.1.2.2 to be acceptable.

The reviewers found the identification of RRC SSCs to be conditionally acceptable. The RRC SSCs were identified in PSAR Volume III, Table 3-6. RRC SSCs are systems LCP, LFP, and RLD[106] piping, fittings, valves, process vessels, and process vessels liquid level detection and alarms. The PSAR did not identify instrumentation and controls required to place the facility in a safe state as ITS SSCs, as required by SRD Safety Criterion 4.3-4. In response to Question LAW-PSAR-066, BNI committed to include a complete list of all RRC SSCs (including the ones described above) with associated safety functions in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

2. **Safety Function** – The reviewers found the safety function descriptions of SSCs designated SDC and SDS to be conditionally acceptable, as described in PSAR Volume III, Chapter 4. For each SDC and SDS SSC identified, the PSAR included a section that described the credited safety function. The reviewers found the safety function descriptions to be acceptable because they were consistent with the hazard control requirements identified in SIPD, as related to the DBEs, and were consistent with the requirements of the SRD.

   The reviewers found that the safety functions of the SSCs designated RRC were described adequately in PSAR Volume III, Table 3-6. However, as noted in Item 1 above, the list of RRC SSCs in Table 3-6 did not include all ITS SSCs that were not designated as either SDC or SDS in PSAR Chapter 4 (as described in the preceding

[106] LCP – LAW concentrate receipt process system; LFP – LAW melter feed process system; RLD – radioactive liquid disposal.

paragraphs of this SER). As part of the same deficiency, reviewers noted that safety functions of RRC SSC instrumentation and control required to place the facility in a safe state were not provided, as required by SRD Safety Criterion 4.3-4.

As described earlier in Section 4.1.2.2, BNI committed to include a complete list of RRC SSCs, with associated safety functions, as committed to in response to question LAW-PSAR-066, with the first PSAR revision following authorization for full facility construction.

3. **Safety System Description** – The reviewers found the system descriptions of SSCs designated SDC and SDS to be acceptable, as described in PSAR Volume III, Chapter 4. For each SDC and SDS SSC identified, the chapter included a section that described the SSC. The reviewers found the descriptions to be acceptable because they were consistent with the hazard controls determined through the ISM process and documented in SIPD and with the applicable requirements of the SRD, specifically Safety Criteria 2.0-1, 2.0-2, 4.2-2, and 4.3-4.

   In accordance with the approved version of 24590-WTP-ABCN-ESH-01-029, system descriptions for RRC SSCs are not required in the PSAR. This was acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazard and accident results documented in the LAW PSAR and detailed descriptions of RRC SSCs are not required to adequately document the facility safety basis.

4. **Functional Requirements** – The reviewers found the functional requirements of SSCs designated SDC and SDS to be acceptable, as described in PSAR Volume III, Chapter 4. For each SDC and SDS SSC identified, the chapter included a section that described the functional requirements of the SSC.

   During the review process, reviewers found it necessary to obtain additional information and clarification of the functional requirements for SSCs designated SDC and SDS. In Question LAW-PSAR-029, reviewers questioned the electrical power to the melter offgas system and the associated control system, including load demands on the UPS batteries that would provide backup power to the melter offgas system and associated controls. In response, BNI stated that three UPS units were provided, each with 45 minutes of capacity. This capacity was greater than the load demand for melter offgas fan power during the offgas system DBE (PSAR Section 3.4.1.1) which requires, according to the response to LAW-PSAR-029, at least two fans operating for 15 minutes and at least one fan operating for the remainder of one hour (i.e., 45 minutes). Approximately 30 minutes after being on UPS power, the facility is evacuated to protect the facility worker. Controls are provided to provide power to at least one fan during this period. Reviewers found these functional requirements for the UPS power for the offgas system to be acceptable. (See also related discussion on worker evacuation commitment in Section 4.1.2.2, Item 5, of this SER.)

   The reviewers concluded that the functional requirements provided were commensurate with the level of detail at the preliminary design stage, and the functional requirements

for SDC and SDS SSC were consistent with credited safety functions in the hazard analysis. Therefore, the reviewers found the descriptions to be acceptable.

5. **System Evaluation** – The reviewers found the system evaluations of SSCs designated SDC and SDS to be acceptable, as described in PSAR Volume III, Chapter 4. For each SDC and SDS SSC identified, the chapter included a section that evaluated the functional requirements versus the proposed design information for the SSCs. The reviewers found the system evaluations to be acceptable because they adequately discussed system performance as it related safety functions credited in hazard analysis.

   The reviewers determined that systems evaluations of the RRC SSCs were not provided in LAW PSAR Volume III. Without a more complete description of the RRC equipment, the PSAR did not address whether the RRC SSCs as described could perform their intended safety functions. This evaluation will be completed with the FSAR review.

4.1.3.3 Conclusions

The reviewers concluded that the description of ITS SSCs in the PSAR was conditionally acceptable. The ITS SSCs of the LAW facility will acceptably perform their safety function under all normal, off-normal and accident environmental conditions. The SDS and SDC SSCs in the LAW facility were appropriately identified and described. However, the PSAR did not fully identify and describe all ITS SSCs classified as RRC.

Condition of Acceptance – BNI must complete the following with the first PSAR revision following authorization for full facility construction:

1. Include a complete list of RRC SSCs, with associated safety functions, as committed to in response to Question LAW-PSAR-066. (See Section 4.1.3.2, Item 1.)

4.1.4 LAW Facility TSRs

The purpose of this review was to determine whether the submittal adequately described appropriate draft TSRs for the hazard control provisions for the LAW facility according to the applicable requirements of the Contract. The review should also determine whether PSAR Volume III adequately provided the basis for developing the TSRs to ensure that the facility will operate within the analyzed safety basis.

4.1.4.1 Requirements

SRD Safety Criterion 9.2-2 states, "Technical safety requirements shall be based on the FSAR and any facility-specific commitments made." The BNI Contract, Table S7-1, provides the requirement for submitting draft TSRs and states that draft TSRs will be submitted with the CAR. DOE/RL-96-0003, Section 4.3.2, Item A.18.c, requires that the PSAR requesting construction authorization include a draft of the TSRs. The SRD defined the content of the

TSRs. SRD Safety Criterion 9.2-1 stated that TSRs shall be prepared and submitted for approval, and the facility shall be operated according to the approved TSRs. SRD Safety Criterion 9.2-3 described the standard for TSRs, consisting of safety limits (Item 1) and limited control settings (Item 2a), each of which was further defined in the SRD. Finally, SRD Safety Criterion 9.2-4 stated that TSRs shall be kept current at all times so that they reflect the facility as it exists and as it is analyzed in the safety analysis report.

4.1.4.2 Evaluation

The PSAR included draft TSRs that provided information commensurate with the current preliminary stage of facility design. These draft TSRs included limiting conditions of operation, associated surveillance requirements (mostly to be determined), administrative controls, bases (also mostly to be determined), and design features. No safety limits were identified. The review of the draft TSRs was limited to consistency checks (1) for assurance that safety functions derived in PSAR Sections 3.4.1.x were carried forward to form the basis for the derivation of TSRs in PSAR Chapter 5.0 and (2) between the TSR derivation in PSAR Chapter 5.0 and the draft TSRs. The reviewers noted that limiting conditions of operations and safety requirements were identified to protect the active safety functions of ITS SSCs; design features were identified to protect passive safety functions by maintaining the configurations assumed in the hazard and accident analyses; and administrative controls were defined to describe safety management programs. As noted in Section 3.5 of this SER, the reviewers found the draft TSRs acceptable. Detailed review leading to approval of TSRs will be performed with the review of the FSAR before facility operation is authorized.

4.1.4.3 Conclusions

The reviewers concluded that the draft TSRs provided with the LAW PSAR were commensurate with the preliminary design and were acceptable for full LAW facility construction.

4.2 HLW Facility

The scope of the HLW activities covered in PSAR Volume IV, *HLW Facility Specific Information*, is the full construction of the HLW vitrification facility, systems, and processes.

4.2.1 HLW Facility Description

The purpose of this review was to determine whether the PSAR adequately described the HLW facility and processes that were encompassed by the PSAR and that could affect any safety functions, hazards, or potential accidents (at the completed facility) or their consequences. Examples of facility features are facility location, facility design information, and the location and arrangement of buildings on the facility site. Examples of process features are the general arrangement, function, and operation of major components of the processes for treating HLW.

4.2.1.1 Requirements

The requirements for the HLW facility and process descriptions were parallel to the review criteria listed in Section 3.2.1 and Section 4.1.1.1 in this SER but as applied to the HLW facility and process. The facility and process descriptions were reviewed against criteria in RL/REG-99-05, Section 1.2, "Facility Description," and Section 1.3, "Process Description."

Facility Description – For the HLW facility, the elements of the facility description included (1) facility location, (2) facility site's layout and location of buildings, (3) the facility's ability to resist failures of ITS SSCs, (4) imposed design limits for quantifying the structural behavior of the concrete and steel structures, (5) design and analysis processes used for ITS structures, (6) ITS electrical systems and components, (7) ventilation and air cleaning systems and components, (8) protection of control room atmospheres, and (9) effluent stacks.

Process Description – For the HLW facility, the elements of the process description included (1) a general description of the process, (2) the general arrangement of the major components of the process, (3) a discussion of process design, (4) the operating ranges and limits for process variables, (5) process equipment layout, (6) process design-related codes and standards, (7) instrumentation and controls required for monitoring the process, and (8) process systems for waste management. The process description also included information on process safety as outlined in SRD Safety Criterion 3.1-2, which states, in part, "A compilation of written process safety information appropriate to the stage of design being considered shall be completed to support the process hazards analysis." Process safety was evaluated as element (9).

4.2.1.2 Evaluation

The results of the reviewers' evaluation of facility and process descriptions are summarized separately below.

Facility Description – The reviewers found that the facility description acceptably met five of the nine elements and conditionally met four elements. The reviewers evaluated the HLW facility-specific information contained in PSAR Volume IV, structural and seismic calculations referenced in the HLW PSAR, and responses to reviewers' questions concerning the structural design and analysis of the HLW facility. The evaluation of the information for each element of the review criteria is discussed below:

1. Information on facility location is discussed in Section 3.2.2 of this SER and was found to be acceptable because the information was adequate to perform the necessary safety evaluation and to define the design basis conditions for the HLW facility.

2. The reviewers found acceptable the information on the general layout and location of the HLW facility showing its major structural features; describing the major processes that will be conducted in the facility; and showing the proximity of the HLW building to other WTP buildings, other Hanford facilities, and nearby public facilities and byways. The level of detail provided was adequate for performing a review of preliminary safety analyses necessary for the HLW facility.

3. The reviewers found conditionally acceptable the design information on the ability of the HLW facility to resist failures of its safety functions due to credible internal and external events. Specific conditions of acceptance from the walls to grade SER were adequately completed and are discussed under (b) below.

As part of the PCAR basemat and walls to grade review of the HLW facility, designs and calculations were reviewed and found to be acceptable. Above-grade concrete structures and the steel superstructure design calculations were not completed for the PSAR; however, the structural design criteria were reviewed. The reviewers found design codes and standards for the SC-I HLW building acceptable as presented in 24590-WTP-DC-ST-01-001. These criteria, developed for WTP facilities, provided the minimum structural design criteria for each seismic category building. If properly applied, the criteria ensure that building structures are designed to withstand the effects of natural phenomena events postulated to occur during the life of the building. The criteria also described the natural phenomena events selected, the rationale for their selection, and the bases for the design and evaluation of ITS SSCs. Chapter 5 of 24590-WTP-DC-ST-01-001 detailed the SC-I and -II building requirements for reinforced concrete, structural steel design, and masonry design. Load factors, load combinations, stability requirements, deflection, anchorage, and story drift requirements were established. Specifically, the evaluation included the following types of loads listed in Item 3, Section 1.2.3.3, of RL/REG-99-05:

(a) **Loads Encountered During Preoperational Testing, Startup, and Shutdown –** The PSAR did not address the loads that could be encountered during preoperational testing, startup, and shutdown. In response to an ORP request to clarify the applicability of preoperational testing, startup, and shutdown loads, BNI confirmed[107] the statement in PSAR Volume I, Section 2.4.3.3.1, that "no load cases have been identified for testing beyond those outlined in the criteria for normal operating design conditions," implying that any loads that could be encountered during preoperational testing, startup, and shutdown would not affect the design beyond those outlined in the criteria for normal operating design conditions. The reviewers found this conclusion to be acceptable.

(b) **Loads Encountered During Normal Operation** – The reviewers found acceptable the information on the following loads that could be encountered during normal operation: dead load, live load, snow load, ashfall load, wind load, thermal load, fluid load, pipe reaction load, and the lateral earth pressure load. Some of these loads were defined quantitatively, while others had only the basis for selection described.

SRD Safety Criterion 4.1-2 identifies the implementing code for concrete structures as ACI 349-01, *Special Provisions for Impulsive and Impactive Effects.* Reviewers questioned (Question HLW-PSAR-255) which walls to grade structural calculations demonstrate that the requirements of ACI 349-01 were met.

[107] CCN: 034673, BNI internal memo, D. Houghton to R. Garrett, "Miscellaneous Outstanding Issues Associated with HLW Basemat Design," dated May 31, 2002.

In its response, BNI provided a list of structural calculations that would demonstrate that the walls to grade concrete design satisfied the requirements of ACI 349-01 for normal and accident conditions:

- 24590-HLW-S0C-S15T-00023, *Concrete Structure Analysis Elev. -21-ft to Grade*, Revisions 0, 1, and 2
- 24590-HLW-DGC-S13T-00009, *Exterior Wall Rebar from Elev. -21-ft to Grade*
- 24590-HLW-DGC-S13T-00008, *Interior Wall Rebar from Elev. -21-ft to Grade*, Revisions 0, 1, and 2
- 24590-HLW-DGC-S13T-00005, *Elevated Floor Slab Rebar at El. +0-ft*, Revisions 0, 1, and 2
- 24590-HLW-DDC-S13T-00007, *Embed Plates for Platforms (-31 ft and -21 ft to Elev. 0)*
- 24590-HLW-DDC-S13T-00008, *Design of Embed Plates for Pipe Racks* (*-31 & -21 to Elev. 0)*
- 24590-HLW-DDC-S13T-00009, *Design of Embed Plates for Secondary* (*-31 & -21 to Elev. 0)*
- 24590-HLW-DDC-S13T-00010, *Shield Door Embeds, Partition Plates and Liners* (*-31 & -21 to Elev. 0)*
- 24590-HLW-DDC-S13T-00011, *Embed Plates for Crane and Monorail Supports* (*-31 & -21 to Elev. 0)*
- 24590-HLW-DDC-S13T-00012, *Embed Plates for Bogie Winches and Block Supports* (*-31 & -21 to Elev. 0)*
- 24590-HLW-DDC-S13T-00013, *Embed Plates for Elev. 0'-0" Non-Floor Framing*.

The reviewers established acceptability of these calculations as a condition of acceptance in the walls to grade SER before construction of the HLW facility walls to grade. BNI subsequently provided the walls to grade structural calculations and the reviewers found them to be acceptable. Based on review of those calculations and design methods provided in 24590-WTP-DC-ST-01-001, the reviewers found that BNI's methodology for analyzing concrete structures satisfied the requirements of ACI 349-01 for HLW facility construction authorization and therefore was in compliance with SRD Safety Criterion 4.1-3. On this basis, this condition is closed.

The reviewers concluded that appropriate methodology, data, and assumptions were used for the structural analysis of the facility. The reviewers found the definition of loads in 24590-HLW-S0C-S15T-00025, *Structural Model with Equipment Seismic Loads*, during normal operation to be complete and acceptable for the design of the concrete and steel structures. Based on the review of these calculations and the design methods implemented by BNI, the PSAR for the HLW facility construction authorization was found acceptable and in compliance with Safety Criterion 4.1-3.

(c) **Construction Loads -** The reviewers found the information on construction loads to be acceptable. While the PSAR did not specifically address construction loads, the PSAR Volume I and HLW-specific Volume IV, Section 2.4.3.3.1, identified surcharge design loading of 250 lb/ft^2 for outside and adjacent structures, including those associated with construction. For example, in calculation report 24590-HLW-S0C-S15T-00025, nonpermanent loads such as movable, roof, and soil loads on walls are considered as design loads. Construction loads are specified in 24590-WTP-DC-ST-01-001, Section 4.15, for steel deck, structural framing, and structures when crane loading is adjacent to below-grade structures. The reviewers found the approach to the structural analysis of construction loads to be acceptable.

(d) **Loads to be Sustained During Severe and Extreme Environmental Conditions** – The reviewers found acceptable the information on the definition of the following loads that may result from severe and extreme environmental conditions and external DBEs: extreme wind load, design basis earthquake load, extreme flood load, and extreme wind-generated missile impact load. The information was acceptable because it was consistent with Table 4-1 of SRD Safety Criterion 4.1-3, the applicable criterion for an SDC SSC. Complementing 24590-WTP-DC-ST-01-001, BNI presented methods to calculate earthquake loads in 24590-WTP-RPT-ST-01-002, *Seismic Analysis and Design Approach*. This document provided dynamic and static analysis methods for SC-I and -II buildings and other SSCs required to withstand the effects of earthquakes without significant damage or loss of the safety function. The analysis criteria addressed development of design response spectra and associated input time histories, soil-structure interaction (SSI) modeling, and analysis and generation of seismic loads and in-structure response spectra. Section 7.2 of 24590-WTP-RPT-ST-01-002 detailed the method of analysis, seismic input motion, dynamic soil properties, SSI foundation modeling, and use of the System for Analysis of Soil Structure Interaction (SASSI) computer program for solving SSI problems with embedded flexible foundations. The reviewers found 24590-WTP-RPT-ST-01-002 met the seismic requirements of DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-3. On this basis the reviewers found the methodology in 24590-WTP-RPT-ST-01-002 to be acceptable.

(e) **Loads Resulting from Abnormal Plant Conditions –** PSAR Volume IV did not specifically address any loads designated as "abnormal plant condition loads." However, in response to an ORP request to further clarify this issue, BNI stated[108] that loads were classified as either normal or accidental, implying that abnormal plant condition loads were treated as a subclassification of accidental loads. The reviewers found this acceptable because the HLW structural design accounted for the loads from all credible accident scenarios postulated in the facility hazard and accident analysis.

(f) **Loads Resulting from Accident Conditions –** Section 4.2.2 of this SER discusses identification and definition of the scenarios involving internal and external DBEs. A subset of these events involved the potential for imposing significant loads on the HLW structure, including molten glass spills, drops of heavy objects onto the basemat, and aircraft impact on the HLW building. The reviewers found this selection of load-imposing conditions acceptable. Structural evaluations for these three types of accident scenarios are addressed below:

(i) Structural Evaluation of Thermal Loads Resulting from Accidental Molten Glass Spill – The reviewers' evaluation of the selection of the size (i.e., quantity) and location of the molten glass spill onto the basemat is addressed in Section 4.2.2 of this SER. Using the accident temperatures associated with a molten glass spill, a structural evaluation was performed and documented in 24590-HLW-S0C-S15T-00016, *Thermal Loads*. The reviewers found the methods used in that evaluation to be acceptable and consistent with SRD Safety Criterion 4.1-2 implementing codes and standards; specifically, the code requirements provided in ACI 349-01.

The reviewers determined that the methodology used in 24590-HLW-S0C-S15T-00016 was an approximate, simplified method. The methodology predicted a low thermal gradient (approximately 21°F) from a 2700-L molten glass spill. The low gradient was a result of BNI's decision during the PCAR review to protect the basemat by adding a 2-ft-wide by 8-ft-long by 6-ft-high catch pan to capture molten glass spills up to 2700 L and a six-inch gap between the catch pan and the basemat. However, the reviewers were concerned (Question HLW-PSAR-220) that the analysis did not appear to accurately model heat sources, HVAC airflow, and heat transfer to predict the temperature conditions for the DBE 2700-L molten glass spill. In response, BNI stated that the catch pan protected the basemat and walls to grade from reaching temperatures beyond the ACI 349-01 accident temperature limit of 350°F. The methodology predicted only a small temperature rise as a result of the spill. During the PCAR review, the reviewers determined that this approach was conditionally acceptable. The PCAR condition required that BNI perform transient computational fluid dynamics analysis of the

[108] CCN: 034673, BNI internal memo, D. Houghton to R. Garrett, "Miscellaneous Outstanding Issues Associated with HLW Basemat Design," dated May 31, 2002.

DBE 2700-L molten glass spill before authorization for full HLW facility construction. BNI performed the transient computational fluid dynamics analysis documented in 24590-HLW-RPT-ESH-02-002, *Comparison of a Computational Fluid Dynamics Model to a HADCRT Analysis for an Unplanned HLW Melter Pour*, and 24590-HLW-RPT-ESH-02-003, *Floor Temperatures from an Unplanned HLW Melter Pour Using CFD; Addendum to Report 24590-HLW-RPT-ESH-02-002*. Using temperatures derived in these calculations, BNI performed and documented a structural evaluation.[109, 110] BNI compared the results of the calculation with the calculated values from the HADCRT analysis. The reviewers determined that the results of the two analyses were consistent, met SRD Safety Criterion 4.1-2, and were therefore acceptable. This condition is closed.

(ii) Structural Evaluation of the HLW Facility Subjected to Impact Loads Resulting from Accidental Drop of Heavy Objects – The reviewers' evaluation of the selection of the size and locations of dropped loads and drop heights is addressed in Section 4.2.2.2, Item 3(b), of this SER. A structural evaluation of the basemat slab for the defined drops was documented in calculation report 24590-HLW-DBC-S15T-00001, *Evaluation of Impact Loads*, and concluded that impact absorbers (SDC, SC-I) will be needed to protect the basemat slab. The reviewers found the structural evaluation of the load drop scenarios to be acceptable.

Bounding load drops above the -21 ft elevation in the HLW facility were considered.[111] The selection criteria BNI used to select representative load drop events included drop height, weight of load, and drop location. A structural evaluation of appropriate floor slabs for the selected drops was documented in 24590-HLW-DBC-S15T-00014, *HLW Building Structural Drop Analysis – for PSAR*. The reviewers found the evaluation to be acceptable because the methodology satisfied ACI 349-01 impact criteria.

(iii) Structural Evaluation of HLW Building Subjected to Impact Loads Resulting from Accidental Aircraft Crash – The impact of aircraft onto the HLW building was evaluated by BNI in calculation report 24590-WTP-Z0C-50-00001. BNI used the methodology and criteria given in DOE-STD-3014-96 for this analysis. The reviewers found the use of this standard acceptable because it provides guidance and data specific to DOE facilities.

[109] CCN: 033351, BNI internal memo, R. Lanning and R. Crowe, to R. Garrett, "Comparison of HADCRT vs. Fluent (CFD) Results for HLW Melter Unplanned Pour (Supercedes CCN: 033350)," dated October 8, 2002.
[110] CCN: 043813, BNI internal memo, R. Jorissen, to R. Garrett, "HLW Structural Effects of Unplanned Melter Pour – HADCRT vs. CFD Thermal Loads (Supercedes CCN: 043051)," dated October 8, 2002.
[111] CCN: 023457, BNI internal memo, D. Cresci to S. Horn, "Load Drops Impacting the HLW Floor >-21 Feet (PSAR)."

In Revision A of 24590-WTP-Z0C-50-00001, the aircraft impact frequency was calculated using the entire HLW building as the target, and the impact frequency was determined to be more than the frequency threshold value of 1×10^{-6}/yr given in DOE-STD-3014-96. As such, credit was taken for the concrete walls and floors to act as impact barriers to protect most ITS SSCs. The impact frequency was recalculated using the reduced target area based only on ITS SSCs that are not protected by concrete walls and floors. In Questions LAW-PSAR-153 and PT-PSAR-220, reviewers asked why the calculation did not completely establish the structural effectiveness of the floors and walls as impact barriers. In response, BNI revised the calculation (Revision B) and stated that the public radiological and chemical exposures that could potentially result from aircraft impact on the HLW building were less than the exposure threshold values given in SRD Safety Criterion 2.0-1 for the public. The reviewers noted that BNI did not calculate exposure to facility workers and co-located workers. However, BNI justified not performing such an evaluation in a revised response to Question LAW-PSAR-153. The reviewers found BNI's justification acceptable because it was consistent with the guidance of DOE-STD-3014-96. In response to Question LAW-PSAR-153, BNI committed to include, in the first PSAR revision following authorization for full facility construction, this evaluation of the aircraft impact on the HLW building and associated justification as stated in the response. The reviewers found this acceptable.

(g) **Load Combinations –** The applicable load combinations for reinforced concrete and structural steel design were listed in PSAR Volume I, Section 2.4.4.1.4.1; in 24590-WTP-DC-ST-01-001; and in 24590-HLW-S0C-S15T-00020, *Concrete Structure Analysis*. As noted in Section 3.2.2 of this SER, the reviewers found these load combinations to be acceptable because they were consistent with the requirements of SRD Safety Criterion 4.1-3 implementing codes and standards, the applicable criterion for the HLW facility SSCs.

4. The reviewers found conditionally acceptable the information on imposed design limits for quantifying the structural behavior of the concrete and steel structures. To evaluate whether the PSAR referenced the appropriate design limits and structural acceptance criteria, the reviewers evaluated the calculations used for the basemat design. The reviewers also evaluated the analysis methods and load combinations used to determine design basis moments, shears, and forces in the basemat resulting from normal operating loads. The reviewers found the methods used in these calculations and the results to be acceptable because the methods used to determine the demands and capacities were consistent with SRD Safety Criterion 4.1-2 implementing standard DOE-STD-1020-94. The reviewers also found the walls to grade to be structurally adequate because the demand/capacity ratios for the most critical areas of the walls to grade were acceptable. These ratios were calculated considering the combined effects of thermal growth and through-thickness gradient and other applicable loads using the same method used for the basemat. Given the level of calculations available at the PSAR stage, the reviewers found the concrete design acceptable for the entire facility.

In their review of the structural calculations, the reviewers identified inconsistent methods for determining anchor capacities but, after further review discussed below, found the revised methods acceptable. Initial calculations used both cracked and uncracked concrete properties but provided no basis. This method was not consistent with the requirements of SRD Safety Criterion 4.1-2 implementing code ACI 349-01, Appendix B, Section B.5.2.6. In response to Question HLW-PSAR-256, BNI committed to review those embedded plates currently designed and stated that, "For those embedments that require redesign, these items will be placed on HOLD until the redesigns are completed. After the calculations are reviewed they will be revised to incorporate the cracked condition allowable loads …. For beam support embedments used only for shoring, the structural concrete sections during construction will utilize uncracked assumptions." BNI stated that the PSAR would be revised to include this commitment in the first PSAR revision following authorization for full facility construction. Subsequently, after revision of the calculations (see Section 4.2.1.2, Facility Description, Item 3[b]), the reviewers found that appropriate methodology, data, and assumptions were used for the anchor capacity analysis of the facility. Reviewers found the commitment acceptable.

5. The reviewers found acceptable the information on the structural design and analysis processes used for the HLW facility, including the process for validating and verifying structural and thermal analysis codes. This information was acceptable because the design and analysis process conformed to the applicable SRD Safety Criterion 4.1-3 implementing codes and standards, including requirements in DOE-STD-1020-94; ASCE 4-98, ANSI/AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*; and ACI 349-01.

6. The reviewers found the PSAR information on electrical systems and components to be acceptable. Factors that could affect potential accidents or their consequences were clearly understood. BNI provided information describing electrical systems and components that were ITS SSCs consistent with the preliminary facility and process design. Electrical systems and components required to mitigate DBEs were identified. Where applicable, the HLW electrical design satisfied the single-failure criterion. Systems and components designated SDC were designed to satisfy Quality Level 1 requirements. The reviewers found the description of the electrical grounding system to be consistent with the industry standards for electrical grounding systems. The reviewers concluded that construction of the grounding grid was acceptable.

7. The reviewers found the information in PSAR Section 2.6 pertaining to the ventilation and air cleaning systems and components to be conditionally acceptable. Calculation report 24590-HLW-MAC-C5V-00004, *HLW C5V HVAC Equipment Sizing and Selection,* analyzed the sizing the C5 ventilation ducts. Three sections of the C5 ventilation ducts are embedded in the HLW facility basemat. Two 24-inch duct sections are vented from the floor of each pour tunnel and routed under the walkway to the drum transfer tunnel. The third section is a 36-inch duct that is routed in the basemat from the secondary offgas area to the filter cave at elevation 0'00". The reviewers found that the C5 exhaust air system, as described, adequately provided the required secondary confinement boundary for released aerosols. The C5 system included the ductwork, filter

trains, fans, stack, and controls that maintain the C5 confinement area at the lowest (most negative) pressure as related to atmosphere and as compared with the other confinement areas of the facility.

Reviewers questioned how the WTP ITS SSCs complied with SRD Safety Criterion 4.1-3 and SRD Appendix A criteria for considering common-cause/common-mode failures for external events, including the impact of volcanic ashfall. Reviewers asked (Question PT-PSAR-257) whether ITS components and systems that require air cooling or intake air would perform their safety functions during and following an ashfall event. In response, BNI committed to analyze the potential effects on ventilation and air-cleaning SSCs of common-cause external events, such as volcanic ashfall, and document the results in the first PSAR revision following completion of the analysis and FSAR for the WTP facilities. In response, BNI also stated that reasonable provisions will be provided to rapidly replace loaded filters, water washdowns, or other means to ensure that ventilation systems can maintain confinement, and the BOF emergency diesel generators (EDGs) and backup air supplies remain operable. The reviewers found this commitment acceptable because it was appropriate for the preliminary design detail.

8. The reviewers found the PSAR information on protecting control room atmospheres for HLW to be conditionally acceptable. BNI stated that the HLW control room was not being designed to remain habitable during accidents that would introduce toxic chemicals or radioactive materials into the control room. BNI stated that personnel can evacuate the control room and the HLW facility safety functions are automatically executed, with no loss in the ability to respond to an emergency situation. The status of the HLW facility would be monitored from the PT facility control room, which is being designed to remain habitable for all credible events and meet the requirements of SRD Safety Criterion 4.3-7.

In the response to Question HLW-PSAR-224 concerning BNI's approach to satisfying SRD Safety Criterion 4.3-7, BNI stated that the PT facility main control room would have monitoring and control capability to achieve and maintain a safe state. In addition to the integrated control network supplying communication between the HLW control and monitoring system and the PT main control room, BNI committed to an appropriately dedicated and hardened control and monitoring capability for HLW that would be available in the PT main control room.

BNI also committed to perform a detailed evaluation to further assess the impact of hazardous material releases on habitability in all WTP control rooms, including the time available for evacuation of the area. The results of this comparison will be used to determine if additional measures should be implemented to maintain a habitable control room environment following an accident. For the current planned HLW operational strategy, the HLW control room was not being designed to be habitable during accidents that could introduce toxic chemicals or radioactive material into the control room.

BNI stated in its response that it would provide initial information (from ISM Cycle III) in the first PSAR revision following authorization for full facility construction and final information when the FSAR is submitted for the following:

(a) A detailed analysis of control room habitability for the facility (including the HLW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the HLW facility to place the facility in a safe state, and to evacuate the HLW facility safely

(b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the HLW design to identify HLW ITS controls and indications that must be provided in the PT control room design to ensure that the HLW can be placed and maintained in a safe state following any DBEs.

BNI also stated in its response that it would include the following requirements in the first PSAR revision following authorization for full facility construction:

(a) HLW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the HLW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4.

The reviewers found theses commitments on control habitability acceptable.

9. The reviewers found acceptable the information on how the effluent stack is represented in 24590-HLW-S0C-S15T-00019, *Steel Structural Analysis*, which describes the structural and seismic modeling of the HLW building. The information was acceptable because the effluent stack was appropriately included in the analytical GTSTRUDL model used for designing the facility. The reviewers noted that the detailed structural design of the stack was not completed but concluded this was acceptable because the stack's structural design loading was included in the HLW building design.

Process Description – The reviewers found that the process description acceptably met six of the nine elements and conditionally met three elements. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found acceptable the discussion of the basic theory of the HLW process, including overview of the operating logic, process flow diagrams, chemical formulae, reaction equations, radiolytic reactions, feed constituents, reagents, products, byproducts, effluents, and other waste streams. In the overview of the HLW process provided in PSAR Section 2.5, the reviewers found that sufficient general information was provided on the process proposed for the HLW facility to support understanding of the hazard and accident analyses and the selection of DBEs.

2. The reviewers found acceptable the information on the general arrangement, function, and operation of major components for the HLW process, as described in PSAR Section 2.5.

3. The reviewers found the process design, materials of construction, equipment design, and process-control logic and instrumentation to be acceptable because they were consistent

with the requirements of the SRD. The reviewers found acceptable the process equipment information, including materials of construction, piping and instrumentation diagrams, electrical design information, relief system design and design basis, ventilation system design, design codes and standards used, material and energy balances, and safety systems. Process equipment information in PSAR Sections 2.4, 2.5, 2.6, and 2.9 was also found to be acceptable.

4. The reviewers found conditionally acceptable the operating ranges and limits of measured process variables used in the engineered or administrative controls. The reviewers found acceptable the process technology information, including block flow or simplified process flow diagrams, process chemistry, and maximum intended inventories. PSAR Section 2.5, process flow diagrams, and 24590-PTF-M4C-V11T-00003, *Pretreatment, HLW, and LAW Vitrification Predicted Maximum Radionuclides*, were reviewed for this evaluation and found to be acceptable. The reviewers concluded that the PSAR contained adequate information on safe upper and lower limits for parameters controlled for safety reasons (e.g., temperatures, pressures, flows, and compositions) and the consequences of deviations.

   Specifically, the reviewers found acceptable the use of a 2-ft-wide by 8-ft-long by 6-ft-high catch pan (2700 L) and physical controls to control molten glass spills, as detailed in calculation report 24590-HLW-U0C-30-00003, *Analysis of HLW Melter Unplanned Pour Using HADCRT Computer Code*. The reviewers also found acceptable the use of an impact absorber to be located in the canister handling tunnel to mitigate canister drops, as detailed in Appendix C of 24590-HLW-DBC-S15T-00001. Based on SRD Safety Criterion 4.2-1 requirements for confinement, the reviewers questioned (Question HLW-PSAR-010) if the vessel vent and overflow lines would be monitored to ensure that their safety functions would be maintained over the 40-year design life of the vessels. In response, BNI committed to monitor the functionality of the vent lines using relative tank headspace pressure as an indication of acceptable ventilation of the tanks and include this commitment in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable because it was appropriate for the preliminary design detail.

5. The reviewers found the information on the HLW facility process equipment layout and general arrangement to be acceptable for the preliminary design of the building. General arrangement drawings[112] that were used in the hazard and accident analysis of the HLW facility did not reflect changes that had been made in the pour tunnel and contained incorrect vessel names and numbers. Revision of the design drawings that were used to support the hazard and accident analysis of the embedded C5 ventilation ductwork to reflect the configuration used in the accident analysis was a condition of acceptance for the walls to grade SER. The drawings were subsequently revised to reflect the design changes made in the HLW pour tunnel, reviewed, and found to be acceptable. Therefore, this condition is closed.

[112] 24590-HLW-P1-P01T-00001, 24590-HLW-P1-P01T-00002, DWG-W375 HV-PL00017, DWG-W375 HV-PL00018, DWG-W375 HV-PL00019, DWG-W375 HV-PL00020, 24590-HLW-P1-P01T-00008, 24590-HLW-P1-P01T-00009, 24590-HLW-P1-P01T-00010, and 24590-HLW-P1-P01T-00011.

6. The reviewers found the codes and standards identified for designing and constructing the HLW processes to be acceptable and consistent with SRD Safety Criterion 4.1-2. For the electrical systems and components, the codes and standards identified in PSAR Volume I were found to be acceptable and consistent with SRD Safety Criterion 4.1-2. The reviewers found design codes and standards for the seismic design of HLW processes/equipment, as presented in 24590-WTP-DC-ST-01-001, acceptable and consistent with SRD Safety Criteria 4.1-3 and 4.1-4. The reviewers found the codes and standards identified for designing and constructing the HLW mechanical systems, including confinement and air treatment systems, acceptable and consistent with the requirements of SRD Safety Criteria 4.1-1, 4.2-1 through 4.2-4, and 4.4-6 through 4.4-8. (In this comparison, consistency with the approved implementing codes and standards for each safety criterion cited above was also verified.)

7. The reviewers found the information on instrumentation and controls for monitoring and safely shutting down the HLW process to be conditionally acceptable. The reviewers asked (Questions HLW-PSAR-224 and -227) how Safety Criteria 4.3-4 and 4.3-7 and their associated implementing codes and standards[113] had been applied to the preliminary designs of the HLW control room and standby control room and how the design of the C2 ventilation system would ensure that the control room atmosphere would be protected during accidental releases. BNI's initial responses indicated that if evacuation of the HLW facility were necessary, BNI planned to monitor the HLW processes in the PT main control room but would not be able to control those processes from the PT control room, leaving the facility to operate unattended in a standby mode. A condition of acceptance for HLW control room habitability was identified and is discussed in Section 4.2.1.2, "Facility Description," Item 8, of this SER.

8. The reviewers found acceptable the information on the design of the facility process systems for minimizing the production of radioactive and nonradioactive wastes. This information was addressed in 24590-WTP-PL-ENV-01-004; PSAR Volume I, Section 9.3.2; Section 8 of 24590-WTP-PL-ENV-01-006; and various sections of 24590-WTP-PL-RT-02-001. The quantities of chemicals added to the process were determined by BNI to be necessary to vitrify the HLW and treat the melter offgases. The reviewers concluded that waste streams would be appropriately recycled to minimize the production of new waste volumes.

9. The reviewers found the information related to process safety information to be conditionally acceptable. This review focused on the requirements of the SRD, Appendix A, Section 4.1, "Identification of Hazards"; and Safety Criteria 3.1-2 and 4.2-3. The reviewers found acceptable the information provided on hazardous materials, including toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials that could occur. Hazards of the various chemicals were provided in 24590-WTP-RPT-ESH-01-001 and Material Safety Data Sheets. HLW PSAR Tables 3-3, 3-4, and 3-5 summarized the process chemicals used in the HLW

[113] For example, NUREG-0800, *Standard Review Plan for Reactors*, Section 6.4.

building, their characteristics, and their potential interactions. In addition, Appendix A included several chemical hazard situations. However, reviewers questioned (Question HLW-PSAR-017) how SRD Safety Criterion 4.2-3 was met in view of cited shortcomings in the HLW PSAR identification and characterization of glass-forming chemicals and questioned (Question HLW-PSAR-071) compliance with SRD Safety Criterion 2.0-1 based on identified inconsistencies and omissions between the PSAR text and tables. In response, BNI committed to revise several PSAR tables to eliminate shortcomings in the chemical compatibility assessments identified by the reviewers. BNI stated that this revision would be completed in the next PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

Although required by SRD Safety Criterion 3.1-2, BNI did not include in the PSAR an assessment of the hazards associated with the chemicals contained in the waste feed. In response to Question HLW-PSAR-121 about this absence, BNI referenced calculation report 24590-PTF-M4C-V11T-00003 and stated that protection of personnel from these chemical hazards was afforded by the same SSCs that were specified to control the radiological hazards of the feed material. The reviewers agreed with this conclusion.

4.2.1.3 Conclusions

The conclusions for the facility and process descriptions, including process safety information, are summarized separately below.

Facility Description – The reviewers concluded that the facility description was conditionally acceptable.

Two conditions of acceptance originally identified in the HLW PCAR SER, and in effect in the authorization basis, were completed:

1. Perform transient computational fluid dynamics analysis of the DBE 2700-L molten glass spill before authorization for full HLW facility construction. (COMPLETE) (See Section 4.2.1.2, Facility Description, Item 3[f][i].)

2. Provide the seventeen structural calculations that demonstrate structural design adequacy of HLW walls to grade as described in Section 4.2.1.2, Facility Description, Item 3(b) of this SER. (COMPLETE)

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Include an evaluation of the aircraft impact on the HLW building and associated justification, as committed to in response to Question LAW-PSAR-153, with the first PSAR revision following authorization for full facility construction. (See Section 4.2.1.2, Facility Description, Item 3[f][iii].)

2. Include the commitment to design anchorage using cracked concrete properties, as committed to in response to Question HLW-PSAR-256, with the first PSAR revision following authorization for full facility construction. (See Section 4.2.1.2, Facility Description, Item 4.)

3. Include information on the analysis of the potential effects on ventilation and air-cleaning SSCs of common-cause external events, including volcanic ashfall, in the first PSAR revision following completion of the analysis and in the FSAR, as committed to in response to Question PT-PSAR-257. (See Section 4.2.1.2, Facility Description, Item 7.)

4. Provide, as committed to in response to Question HLW-PSAR-224, initial information (from ISM Cycle III) in the first PSAR revision following authorization for full facility construction and full information when the FSAR is submitted, for the following (see Section 4.2.1.2, Facility Description, Item 8):

   (a) A detailed analysis of control room habitability for the facility (including the HLW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the HLW facility to place the facility in a safe state, and to evacuate the HLW facility safely

   (b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the HLW design to identify HLW ITS controls and indications that must be provided in the PT control room design to ensure that the HLW can be placed and maintained in a safe state following any DBEs.

5. Include the following commitment in the first PSAR revision, following authorization for full facility construction, as stated in response to Question HLW-PSAR-224: HLW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the HLW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4. (See Section 4.2.1.2, Facility Description, Item 8.)

Process Description – The reviewers concluded that the process description was conditionally acceptable.

Conditions of Acceptance - One condition of acceptance originally identified in the HLW PCAR SER and in effect in the authorization basis, was completed:

1. Revise the design drawings that were used to support the hazard and accident analysis of the embedded C5 ventilation ductwork to reflect the configuration used in the accident analysis with the first PSAR revision following authorization for full facility construction. (COMPLETE) (See Section 4.2.1.2, Process Description, Item 5)

Conditions of Acceptance – BNI must complete the following in the first PSAR revision following authorization for full facility construction:

1. Include information on monitoring vessel vent and overflow lines to ensure their functionality, as committed to in response to Question HLW-PSAR-010. (See Section 4.2.1.2, Process Description, Item 4.)

2. Revise HLW PSAR Tables 3-3, 3-4, and 3-5 to eliminate shortcomings in the chemical compatibility assessments identified by the reviewers, as committed to in response to Question HLW-PSAR-017. (See Section 4.2.1.2, Process Description, Item 9.)

4.2.2 HLW Facility Hazard and Accident Analysis

The purpose of this review was to determine (1) whether the PSAR adequately described the hazard and accident analyses performed for the HLW facility and (2) whether the analyses complied with requirements of the SRD and were consistent with the commitments of the ISMP. The review also was to determine whether the analyses demonstrated that the HLW facility construction, operation, maintenance, and deactivation could be performed in a manner that adequately protects the health and safety of the workers, the public, and the environment.

4.2.2.1 Requirements

In accordance with SRD, Volume II, Appendix A, Section 4.0, "Hazard Evaluation," the PSAR was to address the following nine elements of hazard and accident analyses: (1) identifying hazards, (2) identifying potential accident/event sequences, (3) estimating accident consequences, (4) estimating accident frequencies, (5) considering common-cause and common-mode failures, (6) defining DBEs, (7) defining the operating environment, (8) identifying potential control strategies, and (9) documenting the hazard evaluation.

Specifically, for internal DBEs, the PSAR must document the identification and analyses of internal DBEs that affect the design and the process used to define DBEs.[114] For external DBEs, the PSAR must assess both selection of the seismic events for the HLW facility and the seismic design criteria.[115] Facility preliminary seismic analyses must be evaluated to ensure that the design would meet applicable requirements for load when subjected to the design-basis earthquake. The PSAR also must evaluate other external DBE events, such as design-basis winds, missiles propelled by wind, volcanic ash and snow loads, and man-made external events such as aircraft crashes.

Additionally, consistent with the preliminary design, the evaluation must assess the chemical process safety of the design and whether potential chemical hazards associated with the HLW facility were adequately identified.

[114] RL/REG-99-05, Section 4.5, "Internal DBEs."
[115] RL/REG-99-05, Section 4.6, "External DBEs."

4.2.2.2 Evaluation

The reviewers evaluated the HLW facility-specific hazard and accident analysis in the PSAR as it pertained to construction of the HLW facility. Specifically, the reviewers evaluated the information provided in PSAR Chapter 3 and Appendix A. The reviewers also evaluated PSAR references to assess the scope, breadth, and depth of the detailed information underlying the discussion and to determine the completeness and accuracy of the underlying information in supporting the conclusions. These references included calculations, studies, drawings, system notebooks, additional detailed printouts from the SIPD, system description reports, and other relevant supporting documentation. The calculation reports included in Section 8.0 of this SER were also reviewed to determine the implementation and documentation of the ISM process as it applied to the HLW hazards and accident analysis results.

The reviewers found three of the nine criteria to be acceptable and six to be conditionally acceptable for full facility construction authorization. The evaluation of the information for each review criterion is summarized below:

1. **Identifying Hazards** – The reviewers found the identification of hazards in the PSAR to be conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and the Appendix A CSD records and the results of the hazard analysis in report 24590-WTP-RPT-TE-01-002, *Design Basis Event Selection for the High Level Waste Vitrification Facility, Preliminary Safety Analysis Report*. The reviewers evaluated the results of the identification of hazards associated with the processes, design, and operations that could affect the HLW facility and a list of those hazards, their potential consequences, possible causes, and estimated initiating frequencies.

   The reviewers found that the radiological hazards associated with the HLW facility were identified systematically according to the SRD, Appendix A, Section 4.1, "Identification of Hazards."

   For the HLW building, the PCAR identified all CSD records in Appendix A and basemat-affecting hazards in Appendix C that could produce radiological consequences above SL-4 and chemical consequences above threshold (as defined in the SRD, Appendix A, for severity levels and in SRD Safety Criterion 2.0-2 for chemical consequence thresholds). For the full HLW facility, the PSAR similarly identified hazards in Appendix A and provided a tabulation in Appendix B of hazards affecting walls to grade. BNI provided a complete hazard identification, including SL-4 hazards, in 24590-WTP-RPT-TE-01-002. PSAR Section 3.3.2 documented the hazards identification results, which included identification of the hazardous chemicals and a discussion of possible chemical interactions. The hazard evaluation results were provided in PSAR Section 3.3.3 and in Appendix A. Results were included for the HLW common areas, receipt and blending systems, melter and melter offgas systems, canister handling and storage areas, maintenance and breakdown area, liquid effluent systems, reagent systems, HVAC systems, and instrument and control and utility supply systems. Hazardous situations were identified involving chemical releases, loss of contamination control, spray leaks, canister drops, fire, boiling, explosion, liquid spill, vessel overflow, pressurized release, seismic event, direct radiation, criticality, chemical reaction, offgas

release, and molten glass spills. Of the 602 CSD entries reviewed in the HLW facility hazards identification process, 178 had SL-1 and -2 and above threshold consequences to the facility worker, and 87 had SL-1 or -2 consequences to the co-located worker.

During the reviews of the HLW PCAR and PSAR for walls to grade, the reviewers identified many discrepancies between the CSD records in Appendix A and the HLW PCAR and PSAR text and tables. As part of the authorization agreement for the LAW and HLW walls to grade construction, BNI committed to correct those discrepancies in the first PSAR revision following authorization for full facility construction. Reviewers found this commitment to be acceptable. This condition of acceptance remains open and is discussed further in Section 4.1.2.2.

The HLW facility was preliminarily categorized Hazard Category 2 using DOE-STD-1027-92. The reviewers evaluated the basis for this categorization (24590-HLW-Z0C-U10T-00001, *HLW Facility Hazard Categorization and Chemical Hazards Identification*) and found it to be acceptable.

The reviewers identified a potential hazardous condition in the HLW facility because of the accumulation of flammable concentrations of ammonia. Specifically, the reviewers questioned (Question HLW-PSAR-240) whether ammonia contained within the HLW feed entering the facility could be released from the liquid phase into the gaseous phase by processes that could change the solubility of the ammonia, such as addition of concentrated sodium hydroxide. Reviewers postulated that if sufficient quantities were present and released at a sufficient rate, the ammonia concentration could exceed the lower flammability limit of 15% and ignite. SRD Safety Criterion 4.1-1 requires the facility design to provide for the prevention and mitigation of risks associated with radiological and chemical material inventories and energy sources. In response, BNI committed to analyze this hazardous situation and document the results in the first PSAR revision following authorization for full facility construction. Notwithstanding the incomplete PSAR hazard analysis, the reviewers found this commitment acceptable because the control strategies for all deflagration events, including ammonia deflagrations, will be based on prevention, will not impact the design of the HLW structures, are anticipated, and will be incorporated in the PSAR well before construction of these features is required.

Using the requirements of SRD Safety Criterion 4.1-1 as the basis, the reviewers also questioned (Questions HLW-PSAR-024 and -064) whether explosive levels of ammonium nitrate could form and accumulate in the heat exchanger and offgas ventilation ductwork downstream of the selective catalytic reduction equipment. In response, BNI committed to continue surveillance of the DM1200 test melter testing "to validate that accumulation of ammonium nitrate does not occur." Also, in response to Question HLW-PSAR-024, BNI committed to determine whether there are "regimes in the offgas system propitious for formation and deposition of ammonium nitrate" that affect the hazard analysis. BNI committed to complete the evaluation and include the results in the first PSAR revision following authorization for full facility construction. The reviewers considered these commitments to be acceptable because the likelihood that

additional control strategies affecting the approved PSAR design would be necessary as a result was judged to be remote.

Reviewers questioned (Question HLW-PSAR-127) compliance with SRD Safety Criterion 3.1-3 concerning the required content of the process hazard analysis, given that certain vessel overflow events were not included in the PSAR. In response, BNI stated that the consequences of the event identified by the reviewers were bounded by the offgas release due to a failure of the submerged bed scrubber level indicator, but that the control strategy for the identified event would be different (i.e., would include stopping the flow of cooling water). BNI committed to add a corresponding event (CSD record) to address a leak of cooling water from the submerged bed scrubber condensate vessel cooling coil into the vessel and to identify appropriate control strategies. BNI committed to provide the revised information on overflow events in the first PSAR revision following authorization for full facility construction. The reviewers found this response acceptable because the additional control strategies that would likely be required (e.g., stopping cooling water flow) to mitigate the event are anticipated and will be incorporated in the PSAR well before construction of these features is required.

SRD Safety Criterion 4.1-5 requires SDC SSCs to be protected from the dynamic effects of failures of moderate and high energy systems. The PSAR did not address the potential interactions between the non-ITS auxiliary systems high energy line breaks or the moderate energy line breaks and the ITS SSCs. In response to Question HLW-PSAR-119 in which the reviewers asked where in the PSAR the impacts of failure of non-ITS auxiliary systems on ITS SSCs were addressed, BNI described a part of the ISM process to evaluate these interactions and committed to implement this process as follows: "As part of the continuing ISM process, when specific SSCs and locations and piping and electrical routing are established, spatial issues will be reviewed including development of a hazards topography providing a more detailed evaluation of potential SSC interactions will be performed, per SRD Criteria 4.1-5 (high energy system failures) and SRD Appendix A requirements for Common Cause/Common Mode Failures. For high and moderate energy pipe failures in areas affecting ITS SSCs or which could result in the release of radiological or process chemicals the following process will be used…". This commitment was acceptable to the reviewers because it was appropriate for the preliminary design detail.

2. **Identifying Potential Accident/Event Sequences** – The reviewers found the approach to identifying potential accident/event sequences in the PSAR to be conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and Appendix A CSD records and the results of the hazard analysis in 24590-WTP-RPT-TE-01-002. The reviewers evaluated the results of the systematic and structured process for identifying potential accident/event sequences associated with the processes, design, and operations. The PSAR identified CSD records for hazards that could produce radiological consequences above SL-4 and chemical consequences above threshold for the full HLW facility. The CSD records included information on the potential consequences, a summary of their hazardous situations or sequences, estimated initiating frequencies, control strategy elements, and safety case requirements of administrative controls or engineered features for each hazard. PSAR Section 3.3.3 summarized potential hazardous situations or

accident sequences for the SSCs by their location. The PSAR described the rationale for sorting internal hazardous situations (internal events) into accident groups or categories (e.g., liquid spills and chemical reactions) and for selecting specific cases to be analyzed in more detail and the basis for selecting the accident sequences. PSAR Section 3.4.2 described the external events. Both internal and external event sequences are discussed below:

(a) **Internal Events** – The reviewers found the description of internal events to be conditionally acceptable. The PSAR identified nine types of postulated internal accidents that could impose functional requirements on design of the HLW facility: (1) liquid spills/overflows/leaks, (2) molten glass spills, (3) canister/waste container drops, (4) hydrogen explosion, (5) melter offgas, (6) fire, (7) loss of contamination control, (8) direct radiation, and (9) chemical hazards (ammonia). Specific concerns with the identification of internal events are outlined below.

SRD Safety Criterion 4.2-1 requires the facility to be designed to retain the radioactive and hazardous material through a conservatively designed confinement system for normal operations, anticipated occurrences, and accident conditions. The reviewers questioned (Question HLW-PSAR-003) whether flooding caused by the extended, uncontrolled release of liquids, such as from a break in a fire water line, could result in floor and wall loadings in excess of design limits. In response, BNI performed a detailed hazard topography of structural impacts from water loading due to potential spills or leaks based on current HLW design information. This evaluation was documented in calculation report 24590-HLW-U0C-30-00006, *Flooding Evaluation for the HLW Facility*, which identified several areas with the potential for water accumulation greater that the floor live load allowance (100 psf). BNI also committed to update the evaluation of HLW internal flooding as part of the common-cause/common-mode failure analysis during ISM Cycle III; to identify control strategies for internal flooding events, as necessary, to prevent unacceptable impacts to the safety function of the structure; and to include this information in the first PSAR revision following completion of the hazard assessment. In addition, BNI committed to revise the HLW PSAR in the first revision following authorization for full facility construction to include the interim information on internal flooding events from the response to Question HLW-PSAR-003.

The reviewers found this commitment acceptable for structural construction of the HLW facility but found that the required flooding event hazard evaluation was incomplete. Therefore, the reviewers recommend that the required flooding event hazard evaluation (for the preliminary design) be submitted to, and approved by ORP, before the start of construction of the nonstructural aspects of the design expected to be credited as SDC or SDS SSCs for the internal flooding event, on a schedule to be mutually agreed to, as required by the Contract, Standard 7(e)(2)(x), as a condition of approval of construction authorization. Because of the partial resolution of the flooding issue described above and previous walls to

grade SER condition of approval on this same issue, HLW PSAR Condition of Acceptance No. 3 is superceded and closed.

In Question HLW-PSAR-188, the reviewers asked for the basis for excluding the overflow of the concentrate receipt tank due to a failed plant wash isolation valve or incorrect valve operation as a hazardous situation. In response, BNI committed to revise PSAR Section 4.4.4 in the first PSAR revision following authorization for full facility construction to explicitly address these situations as well as all incoming feeds as sources to the overflow scenario. The reviewers found the response acceptable because control strategies (e.g., SDS interlocks), could be implemented without structural impacts and because revision of the PSAR to reflect the likely control strategies could be approved well before construction of these features is required.

(b) **External Events** – The reviewers found the description of external events to be conditionally acceptable. The reviewers evaluated PSAR Section 3.4.2 for the impacts of external events on the HLW facility, where such impacts would directly affect the facility or impose any design requirements (e.g., seismic) on the facility. The only external DBE included in the section was the seismic DBE. The analysis of the seismic DBE assumed that during the earthquake all SC-I and -II SSCs continue to function and all SC-III and -IV SSCs fail. The scenario was comprised of multiple events or failures, including process vessel failures, canister drops, melter failures, and bulk chemical vessel failures.

The reviewers asked (Question HLW-PSAR-246) how SRD Safety Criterion 4.1-5 and Appendix A criteria were met without considering all sources of water vapor (e.g., steam from broken non-ITS steam lines and water vapor from failed non-ITS service water lines) in determining the relative humidity conditions for HEPA filters during post-seismic operation. In response, BNI committed to perform additional reviews of the steam and water supply systems during ISM Cycle III. The reviewers found this response acceptable because it was appropriate for the preliminary design detail.

The PSAR considered other external natural or man-made events, such as flooding, wind, ash and snow fall, and aircraft crashes, for their impact on the design. The PSAR concluded that these events had no impact and imposed no additional design requirements on the facility, confirming that the seismic DBE was the only external DBE for the HLW facility. The reviewers partially agreed with the conclusion. Deficiencies associated with the following analysis are discussed in the SER sections indicated:

- Aircraft crashes (see Section 4.2.1.2, Facility Description, Item 3[f][iii])
- Ashfall events (see Section 4.2.1.2, Facility Description, Item 7)
- Transportation accidents (see Section 4.2.2.2, Item 6[c][vi].

Based on the lack of impact on the safety and functional requirements of the facility, the reviewers found the limited reference to the evaluation of secondary

events directly caused by external events (such as hazards from other facilities and pipeline ruptures) to be acceptable.

3. **Estimating Accident Consequences** – The reviewers found the approach to estimating accident consequences to be conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and the Appendix A CSD records and the results of the unmitigated consequence analysis in 24590-HLW-Z0C-W14T-00013, *Revised Severity Level Calculation for the HLW Facility.* The evaluation considered the description of the results of the calculated unmitigated and mitigated consequence analysis for the potential accident/event sequences associated with the process, design, and operational hazards that could affect the facility.

In estimating accident consequences, conservative source term assumptions were applied as described in the PSAR supporting document 24590-PTF-M4C-V11T-00003 and other supporting calculations and documents. However, the reviewers questioned the source term assumptions used as the basis for the shielding design calculations (Questions HLW-PSAR-032, -033, and -035) because they did not appear to be consistent with DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," Item 8. Item 8 requires the radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, to be adequately assessed, sufficiently controlled/mitigated, and adequately documented in a formally controlled PSAR to establish a basis for safe operation and an unambiguous definition of the safe-operating envelope. In Question HLW-PSAR-032, the reviewers asked how source volumes, geometry, and deposition on process equipment surfaces as well as instantaneous process conditions, such as batch transfers between process equipment, had been considered in the hazards analysis. In response, BNI stated that bounding radionuclide inventories were used in the analyses and that radioactive material accumulation and self-shielding were considered in the shielding dose calculations. Question HLW-PSAR-035 asked how BNI had addressed radiological and chemical uncertainties in the HLW facility. In response, BNI stated that the maximum radionuclide concentrations (decontamination factors) were based on the best available information and had contingencies applied to account for the uncertainties in the data. Question HLW-PSAR-033 questioned the assumed concentrations of ^{241}Am, ^{154}Eu, and ^{125}Sb. In response, BNI stated that ^{154}Eu and ^{125}Sb were not significant radionuclides for the HLW facility, and the concentration of ^{241}Am was not an issue for radiation shielding because it was primarily an alpha-emitting radionuclide. Therefore, any uncertainty pertaining to the source terms for these radionuclides would not affect the HLW shielding design. The reviewers found the responses provided to these questions acceptable.

Reviewers questioned the use of less-than-Contract maximum concentrations of certain radionuclides, including ^{241}Am in severity level (unmitigated consequence) and DBE (mitigated consequence) calculations. In response to Question HLW-PCAR-053 concerning radionuclide content, BNI stated that "based on the mitigated consequences for basemat affecting DBEs, the increase in the ULDF (unit liter dose factor) as a result of increasing the ^{241}Am to contract maximum value would not result in mitigated consequences above the radiation exposure standards of SRD Safety Criterion 2.0-1. Therefore, increasing the ^{241}Am concentration to the contract maximum would not affect

the full facility construction. In particular, the embedded C5 ventilation ductwork would not be changed due to a ^{241}Am concentration increase." The reviewers found this response acceptable because calculated mitigated doses in the PSAR are well below the radiation exposure standards.

Based on the requirements of SRD Safety Criterion 3.1-3, reviewers questioned BNI's evaluation of the radiological consequences of a leak from process piping being limited to assessment of the consequences from a crack equivalent to a 0.128-in.-diameter orifice. In response to Question HLW-PSAR-128, BNI stated that the spray analyzed in both DBE and severity level calculations "bounds the consequences associated with an entrainment release or particulate that will deposit (large droplet size) before reaching the HEPA filters." BNI also committed to perform a sensitivity study before the first PSAR revision following authorization for full facility construction to compare respirable releases from a crack to an orifice. The reviewers found this response to be acceptable because the sensitivity study ensures that all crack configurations are evaluated and documented.

The following describes the evaluation of unmitigated and mitigated consequences.

(a) **Unmitigated Consequences** – Unmitigated consequence severity level calculations (24590-HLW-Z0C-W14T-00013) were performed for hydrogen explosions, liquid spills, liquid sprays, canister drops, drum drops, molten glass spills, and crush impact of a HEPA filter. The reviewers evaluated the specific scenarios analyzed for the HLW facility, the assumptions used, and the results of the unmitigated consequence calculations. The reviewers determined that the unmitigated consequence calculations for the postulated accident sequences, except for hydrogen explosions, were acceptable according to the SRD, Appendix A, Section 4.3.1, "Accident Severity Level Identification," for the following reasons: (1) consequences accounted for type, form, and quantity of radioactive material and the energy sources available to interact with the hazardous material; (2) no credit was taken for mitigative or preventive controls; and (3) the consequences were evaluated for ground level releases. For hydrogen explosions, the reviewers asked (Questions HLW-PSAR-197 and -235) whether the conditions and parameter values used for the severity level calculations were bounding in accordance with SRD Safety Criterion 4.1-1. For example, the reviewers noted that the quantity of hydrogen involved in the explosion was not bounding, nor was an explosion in multiple tanks by propagation through a common ventilation system considered in the PSAR. In response, BNI stated that the hydrogen generation correlation used in the hydrogen deflagration analyses was being re-evaluated and committed to re-analyze the DBE and revise the PSAR in the first revision. Further, BNI stated that the severity level to the public from a hydrogen explosion in a HLW concentrate receipt vessel was changed from SL-3 to -1. The responses were acceptable to the reviewers because the controls strategies selected for these events are preventive and would not be changed due to increasing the severity level to the public to SL-1.

(b) **Mitigated Consequences** – The PSAR contained mitigated DBE evaluations of three liquid release DBEs (spills, overflows, and spray leaks); two load drop DBEs (canister drops and secondary waste container drops); and DBEs involving hydrogen explosion, melter offgas, fire, loss of contamination control, direct radiation, and chemical hazards. In addition to these DBE analyses, reviewers evaluated the following supporting documents:

- 24590-HLW-U4C-U78T-00001, *DBE: Liquid Spills*
- 24590-HLW-Z0C-30-00001, *DBE: High Level Waste Canister Drops*
- 24590-HLW-Z0C-30-00004, *Design Basis Event: High Level Waste Secondary Waste Container Drops*
- 24590-HLW-Z0C-30-00007, *Design Basis Event: High Level Waste Facility Fire*
- 24590-HLW-Z0C-32-00001, *Design Basis Event: Loss of Contamination Control*
- 24590-HLW-Z0C-H01T-00001, *Design Basis Event: HLW Process Vessel Hydrogen Deflagrations*
- 24590-HLW-Z0C-H01T-00002, *Design Basis Event: HLW Process Vessel Overflow Calculations*
- 24590-HLW-Z0C-H01T-00003, *Design Basis Event: HLW Direct Radiation Exposure*
- 24590-HLW-Z0C-HOP-00001, *Design Basis Event: HLW Melter Offgas Release*
- 24590-HLW-Z0C-HOP-00002, *Design Basis Event: HLW Ammonia Release*
- 24590-HLW-Z0C-S30T-00001, *Design Basis Event: HLW Facility Seismic*
- 24590-HLW-Z0C-W14T-00016, *Spray Leak in the V31001/31002 HLW Feed Receipt Vessel Transfer Line*.

The reviewers concluded that the appropriate methodology, data, and assumptions were used in the analyses. The analysis results were acceptable and consisted of final control strategy selection, mitigated consequences with the credited mitigative and preventive controls, and compliance with SRD Appendix A criteria for meeting the radiation exposure standards of SRD Safety Criterion 2.0-1 and target frequency (initiating event combined with failure of credited controls). The

reviewers considered the estimation of mitigated accident consequences for the DBEs, except molten glass spills, to be acceptable according to the requirements of SRD Safety Criterion 4.3-2. The molten glass spill analyses are conditionally acceptable and are discussed below.

As described in calculation report 24590-HLW-DBC-S15T-00001, BNI analyzed canister drops at ten locations, of which drops at three locations were credible. Of the three credible canister drops analyzed, two were determined to have no detrimental impact while one caused damage to the basemat. An impact absorber was specified to mitigate canister drops to prevent damage to the basemat. This was acceptable to the reviewers.

PSAR Section 3.4.1.4 identified three molten glass spill DBEs. The three molten glass spills are discussed in 24590-HLW-Z0C-HMP-00001, *HLW Molten Glass Spills*, and calculation reports described below:

- The first DBE glass spill involved the spill of the entire inventory of the HLW melter because of a catastrophic failure of the SC-III melter from a seismic DBE (6600 L of molten glass and 50 gpm of cooling water from failure of the melter cooling system). This event was documented in calculation report 24590-HLW-U0C-30-00001, *HLW-Melter Glass Spill Transient Calculation Using HADCRT Computer Code*, and consisted of failure of the melter shell and spilling of the molten glass and cooling water onto the floor of the melter cave and pour tunnel. The calculation concluded that a rapid pressurization of the melter cave would occur with a peak pressure of approximately 9.5 inches water gauge. The reviewers noted that the pressure differential across the HEPA filters from the pressure buildup in the melter cave could challenge the pressure differential limitations of the HEPA filters prescribed in ASME AG-1, "Code on Nuclear Air and Gas Treatment," an implementing standard for SRD Safety Criterion 4.4-6. In response to Question HLW-PSAR-150, BNI stated that the PSAR text will be changed in the first revision following authorization for full facility construction as follows: "The melter shell shall be qualified to SC-II." Because the seismic classification of the melter shell was changed to SC-II, this scenario is no longer credible. In response to a subsequent reviewer question (Question HLW-PSAR-253), BNI committed to remove the 6600-L molten glass spill as a DBE from PSAR Section 3.4.1.4 during the first PSAR revision following authorization for full facility construction. Because the change of the melter shell to SC-II eliminates this DBE, the reviewers found these responses to be acceptable.

- The second molten glass spill involved moving the canister away from the pour spout and continuing to pour 1210 L of molten glass onto the pour cave floor. BNI decided, during the review period, to revise the size of the molten glass spill assumed for this accident to 2700 L of glass. Based on reviewer questions (Question HLW-PCAR-012 and HLW-PSAR-191)

concerning the ability to comply with SRD Safety Criterion 4.4-2 considering the thermal response of the pour cave structure to the molten glass spill, BNI identified a change to the PSAR facility description, to provide a catch pan (2 ft wide by 8 ft long by 6 ft deep) mounted 6 inches above the pour tunnel floor with insulation and an air gap between the catch pan and concrete floor. The section of the embedded C5 ventilation duct, which is routed from the pour tunnel floor to the drum transfer tunnel, was not credited as providing a safety function in the hazard analysis in 24590-HLW-U0C-30-00003, Revision B. This calculation was revised (as Revision C) to include the inadvertent melter pour with the C5 ventilation duct blocked to demonstrate that this portion of the C5 ventilation system could be blocked as a result of a glass spill accident without adverse consequences. Specifically, if the 24-inch embedded exhaust duct became blocked, the minimum required C5 ventilation flow would be maintained by flow through openings in the melter cave. BNI stated in its response that the 2700-L glass spill could be accommodated by the credited controls (insulation, catch pan under pour spout) without imposing any additional functional requirements on the basemat, walls to grade, and embedded C5 ductwork. Based on review of the calculation report 24590-HLW-U0C-30-00003, Revision B, the reviewers found the commitment to revise the PSAR description of this DBE in the first PSAR revision following authorization for full facility construction to be acceptable.

- The third molten glass spill DBE involved an overfill or overflow of the canister onto the pour cave floor. The reviewers noted that this event involved a 100-L glass spill, representative of the planned batch pours to the canister, that could potentially affect the structural integrity of the basemat, walls to grade, and the embedded C5 ventilation duct. Because calculation report 24590-HLW-U0C-30-00002, *Analysis of HLW Melter Pour Spill Using HADCRT Computer Code*, showed that the embedded C5 ventilation duct could reach a temperature of 161°F, a structural evaluation (24590-HLW-S0C-S15T-00016) was performed. The structural evaluation concluded that the impacts from a 100-L spill in the pour cave were acceptable. The reviewers agreed and found this DBE analysis to be acceptable.

4. **Estimating Accident Frequencies** – The reviewers found the approach to estimating accident frequencies to be conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and the Appendix A CSD records and the results of the hazard analysis in 24590-WTP-RPT-TE-01-002. The reviewers evaluated results of the frequency determinations, based on methodology described in 24590-WTP-GPP-SANA-002C for the potential accident/event sequences associated with the hazards from the processes, design, and operations. The following describes the evaluation of the frequency of unmitigated accidents, mitigated accidents, and target frequency:

(a) **Frequency of Unmitigated Accidents** – The reviewers found the description of unmitigated accident frequency to be acceptable. While the overall facility is unique, the DBE initiating events of concern (i.e., leaks, spills, and canister drops), are common industrial events for which historical information concerning frequency of occurrence is available. The unmitigated frequency selection considered the BNI-specified enhanced reliability requirements for the hoisting and rigging equipment and the melter design. PSAR Volume IV included CSD records for identified hazards, including their initiating event frequencies, which had the potential to produce radiological consequences above SL-4 and chemical consequences above threshold with two exceptions: (1) ammonia releases from process wastes followed by a deflagration and (2) ammonium nitrate formation, deposition and explosion. These two hazards are discussed in Item 1 above. A component reliability database of available industry data was compiled from a number of sources, including AIChE's Center of Chemical Process Safety, the Westinghouse Savannah River Company, EG&G Idaho, Inc., the International Atomic Energy Agency, and the Institute of Electrical and Electronics Engineers. This database was used for estimating initiating event frequencies.

(b) **Frequency of Mitigated Accidents** – The reviewers found the description of mitigated accident frequency to be conditionally acceptable. For the analyzed DBEs in the PSAR other than hydrogen deflagration and direct radiation, the selected final control strategies were mitigative rather than preventive. Therefore, the mitigated frequency of the accident sequences, except as discussed below, was the same as the initiating event or unmitigated accident frequency.

The PSAR stated that the mitigated frequency of the hydrogen deflagration DBE was reduced to $<10^{-6}$/yr (beyond extremely unlikely) by the credited control strategies. However, the reviewers found that the PSAR did not use a suitable empirical equation to calculate the hydrogen generation rates. Reviewers asked (Questions HLW-PSAR-235 and PT-PSAR-336) how accident conditions were postulated according to SRD Safety Criterion 4.1-1 when a nonconservative hydrogen generation rate was assumed. In response, BNI committed to revise the calculations related to hydrogen generation rates. As a condition of acceptance for the full HLW construction authorization, BNI committed to revise calculation reports 24590-HLW-Z0C-W14T-00013 and 24590-HLW-Z0C-H01T-00001 to more conservatively account for the radiolytic affects (i.e., the concentrations of the nitrate/nitrite ions by using Equation 2-3 from RPT-W375-SA00002, *Topical Report on the Management of Risks Posed by Explosive Hazards Present at the RPP-WTP*, rather than Equation 2-2) and the thermolytic affects (i.e., by establishing design air purge flow rates through vessel head spaces using an activation energy, e_a, of 100 kilojoules [kJ]/mole [vs. 91k joules/mole] and assuming the vessels are at 220°F), and to revise the PSAR accordingly in the first revision following authorization for full facility construction. Reviewers found these responses acceptable because the control strategy for deflagration events could be implemented without structural impacts and revision of the PSAR to reflect the likely control strategy could be approved well before construction of these features is required.

(c) **Target Frequency** – The reviewers found acceptable the description of the degree to which the target frequency was achieved. Because system air pressure depression or filtration provided by the C5 ventilation system was the active mitigation credited for meeting the radiation exposure standards of SRD Safety Criterion 2.0-1 for all the analyzed DBEs that are not prevented, BNI used calculation report 24590-HLW-U3C-C5V-00001, *HLW C5 System Preliminary Design System Models*, to demonstrate that the frequency of the release for the SL-1 events was $<10^{-6}$ per year, as required by the SRD, Appendix A, Section 5.0, "Development of Control Strategies." The reviewers agreed with the conclusion.

5. **Considering Common-Cause and Common-Mode Failures** – The reviewers found the selection of common-cause and common-mode failures to be conditionally acceptable, as described in PCAR Section 3.3.4, PSAR Section 3.5, the Appendix A CSD records, and the results of the hazard analysis in 24590-WTP-RPT-TE-01-002. The evaluation reviewed the description of credible common-cause events that could affect the safety functions of the HLW facility. This evaluation included considering natural phenomena events, external man-made events, loss of electrical power, fire, internal missiles, and internal flooding.

PSAR Section 3.5 considered two of three broad categories of dependencies to classify and define the common-cause failures that were expected to be important: functional dependencies, spatial dependencies, and institutional dependencies. Each represented a different way in which commonalties between redundant systems, trains, or components could potentially reduce the overall expected reliability.

Functional dependencies are caused by the reliance of multiple systems, trains, or components on a single system, train, component, or process condition. Functional dependencies were evaluated to ensure that the reliance of ITS SSCs on other active support systems was recognized and failure modes of these support systems were evaluated to ensure that the ITS SSCs could still perform their associated safety functions during normal and accident conditions.

The internal DBEs for which analyses were included in the PSAR that were not prevented, credited the C5 ventilation system, parts of which are embedded in the basemat for protecting workers. Therefore, a functional dependency of this exhaust system on the offsite power system was identified. This functional dependency was addressed by accounting for the loss of power in calculating the reliability of the C5 ventilation system needed to meet the target frequency criteria. The reviewers found this treatment of functional dependency to be acceptable.

Spatial dependencies determine the impact of failure of two components as a result of their co-location in an area that experiences the effects of (1) internal fires or explosions; (2) internal floods from failed tanks, cooling systems, etc.; (3) externally applied forces and loads from seismic activity, airplane crashes, vehicle crashes, etc.; and (4) natural forces and environmental stressors, e.g., severe weather, lightning, floods, and external fires. Defense against spatial dependencies comes from hardening or protecting each component to make it less vulnerable to the specific hazard of concern and from

physically separating each component to minimize the likelihood of multiple failures from a single casualty.

The reviewers identified a spatial dependency concern regarding the potential for flooding and consequential floor and wall loadings in excess of design limits due to fire water line breaks or other sources of released liquids such as tanks, vessels, and feed lines failures, with the potential to cause a failure to comply with SRD Safety Criterion 4.2-1. This concern and the associated BNI commitments are addressed in Item 2(a) above.

Spatial dependencies were considered in analyzing the seismic DBE by assuming that all SC-III and -IV SSCs will fail and by including the effects of earthquake-induced fires. The review requirements are provided in SRD Safety Criterion 4.1-5. This safety criterion states that SSCs designated as SDC shall be appropriately protected against dynamic effects that may result from failures of moderate and high energy systems or other accident conditions. Although seismic failures were addressed in analyses referenced in the PSAR, the analyses did not include concurrent seismic and seismically induced fire events.

The reviewers questioned compliance of spatial dependency analysis with SRD Safety Criteria 4.1-1, 4.1-3, 4.1-5, 4.2-1, 4.5-3, and 4.5-9 and the SRD, Appendix A, Section 5.0, "Development of Control Strategies," as reflected in the analysis of spatial dependencies and the seismic DBE analysis. In Question HLW-PSAR-119, the reviewers questioned where in the PSAR the impacts of failures associated with non-ITS auxiliary systems on ITS SSCs were addressed. In Question HLW-PSAR-246, the reviewers questioned the rationale for not analyzing in the PSAR all sources of water vapor in determining the relative humidity conditions for HEPA filters during post-seismic operation. Additionally, in Question HLW-PSAR-259, the reviewers questioned whether the PSAR adequately analyzed the consequences of a seismically induced fire that could impact the C5 HEPA filters operability through increased temperature and smoke particulate generation. In response to the reviewers' questions, BNI committed to evaluate the steam and water supply systems and potential SSC interactions, when locations and piping and electrical routing are established as part of the ISM Cycle III. BNI also committed to perform additional seismic impact analyses with regard to smoke-damaged HEPA filters and the projected performance of the HEPA cylindrical filters. Reviewers found these commitments to be acceptable because they were appropriate for the preliminary design level of detail necessary for approval of the PSAR.

The evaluation of the electrical and control systems determined that, in general, the design was too preliminary for a complete review of all common-cause and common-mode failures. The description of the electrical power delivery system in PSAR Volume IV was evaluated against IEEE Standards 308, 379, and 384, which implement SRD Safety Criteria 4.3-2 and 4.4-9. The reviewers found the consideration of common-cause and common-mode failures acceptable based on the preliminary electrical and control system design.

The PSAR mentioned, but did not address, institutional dependencies. Because institutional dependencies arise from operational aspects such as maintenance or

procurement, reviewers concluded that it is acceptable to postpone consideration of institutional dependencies to the FSAR.

6. **Defining DBEs** – The reviewers found the set of DBEs identified for the HLW building to be conditionally acceptable. Based on the ISM process, the selection of internal DBEs for HLW was described in 24590-WTP-RPT-TE-01-002. For liquid spills, the PSAR selected the failure of a HLW concentrate receipt vessel[116] as the bounding- or worst-case accident, with SL-1 unmitigated consequences to the facility and co-located workers and SL-3 to the public. Internal, seismic, and other external DBEs are discussed below:

   (a) **Internal DBEs** – The reviewers found the PSAR acceptably summarized the internal accident sequences identified in the hazard analysis. The identified sequences contained sufficient detail to provide an adequate basis for estimating each accident's consequences and frequency. Each had consequences of at least SL-1, -2, or -3 as defined in the SRD, Appendix A, "Implementing Standard for Safety Standards and Requirements Identification." The reviewers also found that PSAR Volume IV, Chapter 3 and Appendix A, along with the referenced calculations, provided (1) comprehensive and credible accident sequences that identified initiating events with their prevention and mitigation measures, and other contributing phenomena, and (2) the rationale for sorting hazardous situations into accident groups or categories (e.g., liquid spills and chemical reactions). However, the detailed analysis of the 2700-L molten glass spill DBE as discussed in Item 3(b) above, although not included in the HLW PSAR, will be incorporated by BNI in the first HLW PSAR revision following authorization for full facility construction.

   Given the limited experience with melter operations, BNI analyzed two accidents beyond the assumptions of the DBEs in responses to Questions HLW-PCAR-012 and HLW-PSAR-191 to offer perspective on the consequences of large molten glass spills. The first accident was an inadvertent pour of 2700 L of molten glass into a 2-ft-wide x 6-ft-high x 8-ft-long catch pan, mounted 6 in. off the pour tunnel floor, with an additional 4000 L of molten glass spilling to the center of the pour cave floor. This case maximized the pour cave wall temperatures as well as the pressure transient in the pour cave. The maximum concrete wall surface temperature was <250°F. The peak pressure in the pour cave was <8 in. water, which did not significantly impact the cascade airflow. The second accident was a 6600-L (full melter volume) glass spill into a 6-ft-wide x 6-ft-high x 7-ft-long catch pan, which sits directly on the pour tunnel floor. This case maximized the pour cave basemat temperature. The maximum concrete floor surface temperature was <350°F after 10 days and remained below ACI 349-01 code limits for over 10 days following the event. The reviewers found these beyond DBE analyses provided assurance that the consequences of beyond design basis events were not extreme.

[116] CSD-H100/N0016 in the submittal, renamed CSD-HHCP/N0007 based on a comparison of the description of the initiator, the hazardous situation, and the control strategy elements.

Also, the reviewers found the PSAR provided conditionally acceptable information, supplemented by the responses to questions relative to design and analysis of the facility for external DBEs, including seismic and other external facility phenomena and events (e.g., wind, missiles due to wind, flooding, volcanic ash, snow, and postulated aircraft crashes). (See Section 4.2.2.2, Item 2, for the conditions of acceptance for external events.)

(b) **Seismic DBEs** – The PSAR provided information for the eight information areas identified in Section 4.6.3.3.1 of RL/REG-99-05. Evaluation of the information for each area is summarized below:

(i) Seismic Performance Categorization – The reviewers found acceptable the classification of the HLW facility structures, including the basemat, wall connection, and walls to grade, as SC-I based on their SDC classification and the necessity that they function during a seismic event. The reviewers found this acceptable because it was consistent with the requirements of SRD Safety Criterion 4.1-3.

(ii) Selection of Seismic Design Criteria, Seismic Hazard Curve, and Seismic Response Spectra – The reviewers found the analysis methods and design criteria, which were consistent with or more conservative than those in DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-1, to be acceptable. The seismic hazard curve was based on a 1996 site-specific study performed by Geomatrix for the Hanford site.[117] The study was reviewed and accepted earlier by ORP.[118] In 1999, the study was subsequently validated by WTP Contractor personnel as members of the Tank Waste Remediation System (TWRS) Team. The reviewers found the peak ground acceleration of 0.26 g and the DBE response spectra for the HLW facility acceptable because they were consistent with the site-specific hazard curve and SRD Safety Criterion 4.1-3.

(iii) Seismic Analysis and In-Structure Spectra Development Methodology – The reviewers found the seismic analysis and in-structure spectra development methodology to be acceptable. BNI performed seismic analysis of the HLW building considering the effects of SSI during the design basis earthquake using methods that were consistent with DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-3. The design basis seismic loads for the basemat and walls to grade were calculated using the accelerations from the SSI analysis and a method that was conservative and therefore acceptable to the reviewers. The reviewers found the method for developing the in-structure spectra for building supported SSC design to be acceptable because it was consistent with

[117] *Probabilistic Seismic Hazard Analysis, DOE Hanford Site Washington*, WHC-SD-W236-TI-002.
[118] 99-RU-0394, REG letter from D. C. Gibbs to M. J. Lawrence, BNFL, "Acceptance of Peak Ground Acceleration (PGA) for the RPP-P Facility Design Basis Earthquake," dated June 30, 1999.

DOE-STD-1020-94 and ASCE 4-98, as required by SRD Safety Criterion 4.1-3.

(iv) Seismic Acceptance Criteria – The reviewers found the seismic acceptance criteria for building structural components to be acceptable. PSAR Volume IV evaluated or referenced the design adequacy of the HLW basemat by calculating demand/capacity ratios using section capacities based on ACI 349-01 code provisions. The reviewers found this method to be acceptable because it was consistent with DOE-STD-1020-94 and SRD Safety Criterion 4.1-3. In responses to Questions HLW-PCAR-127 and -131 concerning the total design load (including seismic loads, dead loads, live loads, and thermal loads) or demand on the basemat and the capacity, BNI tabulated the demand/capacity ratios at the basemat's critical and highly stressed locations for the critical load combinations including seismic loads. Because the highest demand/capacity value in this tabulation was <1.0, the reviewers found the basemat structural design to be acceptable from seismic considerations, especially because the code permissible capacity was reduced by 15% to create a source of reserve capacity. As noted in Section 4.2.1.2, Facility Description, Item 3(b), BNI submitted walls to grade calculations, including the tabulation of demand/capacity ratios, at highly stressed locations for the critical load combinations, including seismic. The reviewers found the methodology satisfied DOE-STD-1020-94 and ACI 349-01 for basemat and walls to grade, thus demonstrating the adequacy of the methodology for full HLW building construction authorization.

Initially, BNI did not submit similar tables listing the demand/capacity ratios for the basemat-to-wall connections that were essential to establish the seismic design adequacy of the dowels that will make the basemat and the wall monolithic, a fundamental design and analysis assumption. However, in response to Question HLW-PCAR-131, BNI provided similar tabulated values of demand/capacity for the critical and highly stressed basemat-to-wall connections. These values established the adequacy of these connections to withstand the combined shears and moments from seismic and other loads. (See Section 4.2.1.2, Facility Description, Item 3[b], for acceptability of the structural design adequacy of walls to grade.) On the basis that BNI implements the seismic design acceptance criteria for the remainder of the HLW building components to the same level of detail as was done for the basemat, basemat-to-wall connections, and walls to grade (including the preparation and a critical evaluation of demand/capacity ratio tables), the reviewers found BNI's seismic acceptance criteria acceptable for full HLW building construction authorization.

(v) Seismic Detailing and Anchorage Design – The reviewers found the commitment in PSAR Section 2.4.4.1 to detail the reinforcing steel in the

HLW facility including the basemat and walls to grade, according to ACI 318-99, Chapter 21, "Seismic Design," to be acceptable because it was consistent with SRD Safety Criterion 4.1-3. BNI performed or referenced generic designs of anchorage in basemat concrete using criteria and methods in ACI 349-01 as required by SRD Safety Criterion 4.1-3. This approach was also found to be acceptable by the reviewers.

(vi) Evaluation of the Consequences of Beyond-the-Design-Basis Earthquake – The reviewers found the evaluation of the consequences of beyond-the-design-basis earthquake to be acceptable. BNI completed a seismic probabilistic risk analysis to determine if the consequences of the HLW building failing from a beyond-the-design-basis earthquake would meet the radiation exposure standards in SRD Safety Criterion 2.0-1. The results of the preliminary seismic study, summarized in PSAR Section 3.6, show that the seismically induced radiological releases from the HLW facility meet these requirements for the workers, co-located workers, and the public. See Section 4.6 of this SER for further discussion of the seismic probabilistic risk assessment and its contribution to the WTP facility risk goals.

(vii) Seismic Calculation Methods – The reviewers found the methods for calculating the seismic loads and designing the basemat and walls to grade for these and other loads to be acceptable for application to the full HLW building because the methods were consistent with the requirements of DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-3. However, BNI performed the structural design of walls to grade using design basis in-plane shears and out-of-plane bending moments from a series of static equivalent GTSTRUDL analyses and not those from the SSI analyses, as required by ASCE 4-98 and DOE-STD-1020-94. However, BNI compared the two sets of loads[119] (from the GTSTRUDL analyses and the SSI analyses) and concluded that the loads resulting from the SSI analyses envelop those from the GTSTRUDL analyses. The reviewers founds this conclusion acceptable.

(viii) Safety and Operability Functions of the HLW Facility – The reviewers found the description of the safety and operability functions of the HLW building structural components to be acceptable.

The basemat and walls to grade provide structural support to the rest of the building, which includes all ITS and non-ITS SSCs during normal operations and during abnormal events and DBEs, including the design basis earthquake. The reviewers found this functional requirement of the basemat and walls to grade to be acceptable. PSAR Volume IV also assumed that the basemat acts as a secondary barrier against leakage of

[119] CCN: 045342, BNI internal memo, R. Jorissen to D. Houghton, "HLW Dynamic Soil Pressure – SSI vs Static-Equivalent Loading," dated October 25, 2002.

radioactive fluid into the foundation soil. Even though the PCAR did not establish any explicit quantitative criteria to evaluate the basemat's effectiveness in acting as a secondary barrier, the evaluation of heavy canister drop onto the basemat indirectly showed that it assumed the basemat to be an effective barrier because its deformation state satisfied the ACI 349-01 limits for impactive and impulsive loads, as required by SRD Safety Criterion 4.1-3. The reviewers found the accident-related functional requirement to be acceptably met.

The reviewers questioned (Question HLW-PSAR-104) the specific criteria to be applied to the concrete structures to provide confinement of liquids and aerosols. The HLW facility walls, in conjunction with the basemat, penetration seals, and ceilings, perform safety functions to provide confinement/leakage of liquids and aerosols. The reviewers questioned (Question HLW-PSAR-104) the specific criteria to be applied for the performance of this safety function and the method used to satisfy the criteria for walls-to-grade, basemat, penetration seals, and ceiling. BNI stated in response to Question HLW-PSAR-104 that for its function as a confinement boundary, the C5 area boundaries (relative to occupied areas) were limited to less than 6 ft^2 of cracking to support HVAC cascade ventilation. For its function as a secondary confinement boundary for spills, the wet process cell walls, submerged bed scrubber condensate receiver vessel(s) walls, and melter caves (diked areas) walls and floor were required to preclude leaking >32 liters of waste for surfaces bordering an occupied area.

To demonstrate that the BNI design satisfied the criteria, in response to Question HLW-PSAR-104, BNI provided calculations to predict the fluid flow rate through the reinforced concrete wall and basemat/wall interface. However, on detailed review of this calculation, reviewers questioned the crack width sizes used to determine the calculated flow rate through the cracked concrete walls to estimate the doses to 'workers' on the clean side of the cell wall. In its revised response to Question HLW-PSAR-104, BNI stated that it "recognized that this study, and the resulting calculated dose to an individual 'worker', utilize crack widths based on individuals (sic) experience and is provided as an example of what should be anticipated following completion of the detailed design of the reinforced concrete structure. As the detailed design progresses throughout the HLW facility, crack widths will be established and documented in the structural design calculations, ensuring this functional requirement for the reinforced concrete structure is addressed."

The reviewers found BNI's commitment to include crack width evaluations as part of the walls to grade structural calculations to be acceptable as a condition of acceptance of the walls to grade construction authorization. Subsequently, BNI provided structural calculation report 24590-HLW-DGC-S13T-00008, with a GTSTRUDL analysis of the

floor/wall joint in the wet process cell and the south end of the melter cave, which are the areas of concrete that are required to provide secondary containment for liquid leaks from vessels. For these areas of interest, the evaluation determined if compressive forces at the joint existed considering normal operating loads of dead load and thermal. BNI reported, "In both the Wet Process Cell and Melter Caves, the loading on most of the walls is high compression forces, resulting in no horizontal cracks at the floor interface. In the wall with tensile forces, the maximum crack width would be 0.02 mm, with most cracks being smaller." The reviewers found the methodology and evaluation acceptable because it satisfied the secondary confinement requirements of SRD Safety Criterion 4.2-1. The walls to grade SER condition of acceptance is closed.

(c) **Other External DBEs** – The reviewers found the information on the design of the HLW facility for other external DBEs conditionally acceptable, as provided in the PCAR and PSAR, Volume IV, and other documents referenced therein. The other external DBEs were reviewed against the six considerations in Section 4.6.3.3.2 of RL/REG-99-05. The reviewers' evaluations are summarized below:

(i) The reviewers found the selection of the PC-3 design basis wind, as well as the calculation methodology, acceptable because it was consistent with the requirements in DOE-STD-1020-94 and Table 4-1 of SRD Safety Criterion 4.1-3. In 24590-HLW-S0C-S15T-00018, *HLW Environmental, Dead, and Live Loads*, BNI used a design wind speed of 111 mph. BNI used ASCE 7-98, *Minimum Design Loads for Buildings and Other Structures*, methodology to calculate pressures resulting from the design basis wind.

(ii) Reviewers found the selection of the design basis wind-driven missile and the calculation methodology acceptable because they were consistent with the requirements of DOE-STD-1020-94 and Table 4-1 of SRD Safety Criterion 4.1-3. In Section 2.4.3.6 of Volume IV of the PCAR and PSAR, BNI indicated that the HLW building was being designed for a 15-lb timber plank missile with a velocity of 50 mph, striking the facility at 30 ft above the grade.

(iii) PSAR Section 2.4.3.13 stated that river flooding was not applicable for the HLW building because it is located about 150 ft above the maximum postulated flood level. The reviewers agreed with this conclusion.

(iv) The reviewers found the selection of the design basis ashfall loading of 12.5 lb/ft^2 for a PC-3 facility (per 24590-HLW-S0C-S15T-00018) and its application in HLW design acceptable because they were consistent with Table 4-1 of SRD Safety Criterion 4.1-3. BNI considered ash loading concurrent with roof live loading and showed that the facility met the applicable design requirements for withstanding loading due to ashfall.

(v) The reviewers found the selection of the design basis snow load of 15 lb/ft^2 (per 24590-HLW-S0C-S15T-00018) and its application in HLW design acceptable because they were consistent with Table 4-1 of SRD Safety Criterion 4.1-3 and ASCE 7-98. BNI considered snow loading not to be concurrent with roof live loading but showed that the facility met the applicable design requirements for withstanding loading due to snow. The reviewers found this evaluation acceptable.

(vi) BNI performed an evaluation of a postulated aircraft crash into the WTP facilities (24590-WTP-Z0C-50-00001) and concluded that the adverse consequences were within acceptable limits. The reviewers found the evaluation to be conditionally acceptable (see Section 4.2.1.2, Item 3[f][iii] of this SER). BNI's evaluation of other external events was also found to be conditionally acceptable. For other external man-made accident events, reviewers questioned (Question PT-PSAR-204) how potential impacts from secondary events directly caused by external events, such as hazardous chemical releases from transportation accidents, had been addressed. In response, BNI indicated that potential effects of transportation accidents were analyzed for the WTP facilities and documented in PSAR Volume I, Chapter 1. BNI's response stated that transportation activities analyzed at the time of the PSAR submittal did not pose significant risk to WTP. Reviewers determined that this conclusion was based on work performed by BNFL, Inc., in support of the Hazard Analysis Report, a current authorization basis document. BNI performed no additional evaluation to determine if the Hazard Analysis Report information was still acceptable. BNI committed to update the BNFL transportation event evaluation as part of the control room habitability evaluations discussed in responses to Questions LAW-PSAR-207 and HLW-PSAR-224 (see Section 4.2.1.2, Facility Description, Item 8, for more information). BNI committed to include initial results of this evaluation in the first PSAR revision following authorization for full facility construction and to include final results in the FSAR. Reviewers found these commitments to be acceptable because the reviewers verified that the existing analysis of transportation events (done by BNFL for the WTP) remained acceptable for construction authorization pending this revision.

7. **Defining the Operating Environment –** The reviewers found the description of operating environment for the HLW facility acceptable. PSAR Table 3-23 listed parameters including pressure and temperature in affected parts of the facility following the occurrence of each analyzed DBE. The operating conditions under which the identified ITS SSCs must function were found to not be significantly affected by either the internal or external DBEs. The only significant environmental impact caused by a DBE inside the facility was the elevated temperature in the pour cave following a molten glass spill. Reviewers asked (Question HLW-PSAR-191) if compliance with SRD Safety Criterion 4.4-2 (regarding environmental qualification) would be compromised given the environment in the pour cave after a molten glass spill. In response, BNI stated, "The

thermal effects on the walls would be much less pronounced than on the basemat because the glass depth is only a few inches, providing a very limited area causing heating into the walls. There would be minimal impact to the structural integrity of the walls." (Also, the reviewers noted that BNI stated in response to Question HLW-PCAR-012, concerning a 2700-L molten glass spill event, that such a spill does not prevent the basemat or the C5 ventilation system from performing their credited safety functions.) The reviewers found this position to be acceptable.

8. **Identifying Potential Control Strategies** – The reviewers found the identification of potential control strategies to be acceptable. The PSAR identified the potential control strategies for mitigating consequences of the selected DBEs. The HLW PCAR identified the basemat and the embedded C5 ventilation ductwork as the final control strategies for mitigating the basemat affecting DBEs. These control strategies are also applicable to the full facility and were identified in the PSAR. In addition, the PSAR also identified the process vessels, cave and pour tunnel concrete structure, C5 ventilation system, liquid level detection interlock, bogie, bogie positional interlock, canister high-high level interlock, canister cask integrity, impact limiters/absorbers, melter shell, and melter offgas system as the final control strategies for mitigating liquid spills, overflows, leaks, drops, explosion, melter offgas, fire, chemical, direct radiation, and loss of contamination DBEs.

   The reviewers evaluated PSAR Sections 3.3 and 3.4 and the Appendix A CSD records, including control strategy elements and safety case requirements identified in the CSD records in the HLW facility-specific PSAR Volume IV and the results of the selection of hazard control strategies for DBEs in 24590-WTP-RPT-TE-01-002. The evaluation focused on the description of the potential hazard control strategies that were identified to control potential accidents as well as the final control strategies selected for the analyzed DBEs.

9. **Documenting the Hazard Evaluation** – The reviewers found the documentation of the facility hazard evaluation of the basemat, walls to grade, and full HLW facility to be acceptable. Pursuant to the SRD, Appendix A, Section 4.9, "Documentation," the reviewers evaluated the documentation of the HLW facility hazard evaluation as presented in PSAR Chapter 3 and the Appendix A CSD records and in 24590-WTP-RPT-TE-01-004. This documentation of the hazard and accident analysis results was acceptable and consistent with the current status of the facility and process design.

4.2.2.3 Conclusions

The reviewers concluded that the results of HLW facility hazard and accident analysis in the PSAR for the full HLW facility were conditionally acceptable. The reviewers also concluded that, except as discussed below, the hazard information, as supplemented by information in responses to reviewer questions and BNI calculations, was consistent with the preliminary facility and process design. The reviewers determined that, except as discussed below, the radiological, nuclear, and process hazards associated with facility operation, including those

from postulated accidents, had been adequately assessed and that sufficient preventive or mitigative features had been identified.

Three conditions of acceptance originally identified in the SER for the walls to grade were completed and one remains open:[120]

1. Correct the discrepancies between the CSD records in Appendix A and the HLW PCAR and PSAR text and tables, as committed to in responses to Questions LAW-PSAR-069 and -169 and as agreed to in the authorization for construction of HLW walls to grade. (See Section 4.2.2.2, Item 1.) (OPEN – must be closed as part of the first PSAR revision following authorization for full facility construction.)

2. Provide the DBE analysis of the 2700-L molten glass spill accident. (COMPLETE)

3. Complete the hazard and accident analysis of internal flooding, including identification of control strategies required to protect the safety functions of the facility structure, assuming PCAR and PSAR reference structural design, before the start of full HLW facility construction. (COMPLETE; superceded by conditions 4 and 5 below)

Conditions of Acceptance – BNI must complete the following and revise the PSAR accordingly for each condition in the first PSAR revision following authorization for full facility construction (except as noted in Items 5 and 13 below):

1. Analyze the potential for ammonia in the HLW feed to be released from the liquid phase into the gaseous phase, reaching a flammable concentration and igniting, as committed to in response to Question HLW-PSAR-240. (See Section 4.2.2.2, Item 1.)

2. Include the results of the offgas system evaluation for ammonium nitrate deposition potential, including the control strategies, if any, that will be implemented to address concerns identified through this evaluation, as committed to in response to Question HLW-PSAR-024. (See Section 4.2.2.2, Item 1.)

3. Include information on overflow events involving submerged bed scrubber condensate vessels, including control strategies, as committed to in response to Question HLW-PSAR-127. (See Section 4.2.2.2, Item 1.)

4. Include interim information on internal flooding events, as committed to in response to Question HLW-PSAR-003. (See Section 4.2.2.2, Item 2[a].)

5. Submit the internal flooding event hazard evaluation (for the preliminary design) to ORP for approval, and receive DOE approval, before start of construction of the nonstructural aspects of the HLW design expected to be credited as SDC or SDS SSCs for the internal

[120] The HLW walls to grade SER condition of acceptance – submit an evaluation of the combined effects of seismically induced radiological releases from the PT, LAW, and HLW buildings on the workers, co-located workers, and the public through a seismic probabilistic risk analysis study – is addressed in Section 4.6 of this SER.

flooding event, on a schedule mutually agreed to by ORP and BNI. (See Section 4.2.2.2, Item 2[a].)

6. Revise Section 4.4.4 to explicitly address all incoming feeds as sources to the concentrate receipt tank that may result in vessel overflow events, as committed to in response to Question HLW-PSAR-188. (See Section 4.2.2.2, Item 2[a].)

7. Perform a sensitivity study to compare respirable releases from a crack to an orifice and revise the calculations and PSAR, as necessary, as committed to in response to Question HLW-PSAR-128. (See Section 4.2.2.2, Item 3.)

8. Re-analyze the hydrogen generation deflagration DBE and the PSAR based on re-evaluation of the hydrogen correlation used in the event analysis, as committed to in response to Question HLW-PSAR-235. (See Section 4.2.2.2, Item 3[a].)

9. Revise the PSAR to show that the HLW melter shell will be qualified to SC-II, as committed to in response to Question HLW-PSAR-150. (See Section 4.2.2.2, Item 3[b].)

10. Remove the 6600-L molten glass spill as a DBE from PSAR Section 3.4.1.4, as committed to in response to Question HLW-PSAR-253. (See Section 4.2.2.2, Item 3[b].)

11. Include a description of the 2700-L molten glass spill event and associated control strategies, as committed to in responses to Questions HLW-PCAR-012 and HLW-PSAR-191. (See Section 4.2.2.2, Item 3[b].)

12. Revise 24590-HLW-Z0C-W14T-00013, *Revised Severity Level Calculations for the HLW Facility*, and 24590-HLW-Z0C-H01T-00001, *Design Basis Event – HLW Process Vessel Hydrogen Deflagrations*, to more conservatively account for the radiolytic affects (i.e., the concentrations of the nitrate/nitrite ions by using Equation 2-3 from RPT-W375-SA00002, *Topical Report on the Management of Risks Posed by Explosive Hazards Present at the RPP-WTP*, rather than Equation 2-2) and the thermolytic affects (i.e., by establishing design air purge flow rates through vessel head spaces using an activation energy, e_a, of 100 kJ/mole [vs. 91 kJ/mole] and assuming the vessels are at 220°F). This was committed to in response to Questions HLW-PSAR-235 and PT-PSAR-336. (See Section 4.2.2.2, Item 4[b].)

13. Re-evaluate transportation events as part of the control room habitability evaluations and include initial results of this HLW evaluation in the first PSAR revision following authorization for full facility construction and include final results in the FSAR. This was committed to in response to Question PT-PSAR-204. (See Section 4.2.2.2, Item 6[c][vi]).

4.2.3 HLW Important-to-Safety SSCs

The purpose of this review was to determine whether PSAR Volume IV adequately identified and described the HLW facility ITS SSCs, their safety function, and the resulting functional requirements.

4.2.3.1 Requirements

The general requirements for the HLW ITS SSCs are the same as those listed in Section 3.4.1 of this SER but as applied to the HLW facility. The SRD, Appendix A, Section 4.7, "Definition of Operating Environment"; and RL/REG-99-05, Section 4.5.3, "Defining Operating Environments and Performance Requirements," identified the specific requirements.

The reviewers evaluated whether the PSAR Volume IV adequately determined and documented each HLW facility ITS SSC using the format described in Section 3.4.1[121] of this SER. The six elements evaluated for each ITS SSC were (1) SSC identification, (2) safety function, (3) system description, (4) functional requirements, (5) system evaluation, and (6) controls (TSRs). Additional information on the review of TSRs is contained in Section 4.2.4 of this SER.

4.2.3.2 Evaluation

The reviewers found the identification of HLW ITS SSCs acceptable based on review of the identification and performance requirements of the ITS SSCs in PSAR Volume IV. The PSAR included three designations for ITS SSCs: SDC, SDS, and RRC. The concept of RRC as a subset of ITS items was approved in 24590-WTP-ABCN-ESH-01-029.

In the revised SRD Safety Criterion 1.0-8, RRC SSCs were defined as all ITS SSCs that were neither SDC nor SDS. RRC SSCs require application of the SRD, Appendix A, for the selection of performance requirements and standards. BNI was not able to complete the evaluation of the RRC SSCs to the requirements of the SRD, Appendix A, until the next ISM cycle because this category was created after the PSAR was submitted. This cycle will be completed during ISM Cycle III. This was acceptable to the reviewers because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazards and accident analysis results documented in the HLW PSAR and would not be expected to result in significant changes to the facility design or safety conclusions.

Reviewer Questions HLW-PSAR-039, -250, -251 and -252 asked the basis for selecting the SSCs identified as RRC and the standards pertaining to these SSCs. The reviewers accepted BNI responses that committed to apply the RRC definitions in the approved version of 24590-WTP-ABCN-ESH-01-029 and the associated commitment to implement this approach in ISM Cycle III by December 31, 2002.

[121] RL/REG-99-05, Section 4.5.3.3.3, "Regulatory Acceptance Criteria."

The reviewers found the information acceptably met three of the six criteria and conditionally met three criteria. The evaluation of the information for each review criterion is summarized below:

1. **SSC Identification** – The reviewers found the identification of SSCs to be conditionally acceptable. SSCs designated SDC and SDS were identified and described in PSAR Volume IV, Chapter 4. The following SSCs were designated SDC:

   - Facility structure and cell structures
   - Cave structure and layout
   - Tunnel structure and layout
   - Fire barriers
   - C5 area ventilation exhaust system
   - C3 canister storage area ventilation exhaust system
   - HLW vessels (H_2 hazards)
   - Hydrogen mitigation purge and mixing systems
   - High-high liquid level control loop (H_2 mitigation)
   - Pulse ventilation treatment system
   - Mechanical interlocks
   - Emergency electrical power
   - Export casks
   - Impact absorbers
   - Chemical tank and piping for ammonia.

   By examining the DBEs described in the PSAR and the hazard and accident analysis results related to those DBEs, the reviewers concluded that all SDC SSCs were adequately defined and described. Specifically, the reviewers concluded that the list of SDC equipment was complete and that the safety function of each SSC was clear and adequate. In addition, the system description for the hazard controls, their functional requirements, applicable standards, and draft operational controls (TSRs) combined to adequately control the hazards associated with the DBEs.

   The following SSCs were designated SDS:

   - Shield doors and shielded hatches
   - C3 area ventilation exhaust system
   - Offgas treatment system
   - Process interlocks
   - Process vessel cooling water monitoring and isolation
   - HLW vessels (non H_2)
   - Piping
   - HLW melter shell
   - HLW canister handling cranes and lifting devices
   - Secondary waste container cranes and lifting devices
   - Crane rails and bogie rails
   - Bogie interlocks

- Melter overpack and rail endstops.

The reviewers found the identification of SDS SSCs to be acceptable.

The reviewers noted that, although ITS, the SSCs designated RRC were not identified in Chapter 4 and were not identified consistently in PSAR Table 3-9 and Appendix A. In addition, based on the definition of RRC SSCs in the approved version of 24590-WTP-ABCN-ESH-01-029, the identification of RRC SSCs in the HLW PSAR was not complete according to the requirements of the SRD, including SRD Safety Criteria 1.0-8, 4.2-2, and 4.2-4. These deficiencies are discussed in the following paragraphs.

The following SSCs were identified in PSAR Table 3-9 as RRC:

- Canisters and secondary waste containers
- Fire protection system
- Process piping RLD-VSL-00008
- Vessels and installed equipment HCP, HFP, and RLD[122]
- Melter and vessel cooling water system
- Liners, sumps, sump level detection, and ejectors
- Ventilation system cascade interlocks (C5, C3, C2)
- C2 ventilation system
- Facility radiation monitoring including area radiation and continuous air monitors
- Stack discharge monitoring
- Portions of the integrated control network.

Reviewers questioned (Question HLW-PSAR-252) why seven SSCs were listed in Appendix A of the HLW PSAR as RRC but not included in Table 3-9. The seven SSCs that should have been included in Table 3-9 were (1) drains for cabinets, bulges, and sampling enclosures; (2) an alarm on detection of radioactive contamination in nonactive streams (cooling water, condensate, effluents); (3) highly reliable container lifting points; (4) controls to prevent multiple shield/confinement doors/hatches from being opened simultaneously; (5) controls to stop injection of ammonia on low temperature in the selective catalytic reduction unit; (6) a container tracking system linked with crane controls to prevent misplacement of canisters/waste bins/drums; and (7) spatial interlocks on cranes to prevent load or crane collisions. In response to the question, BNI stated that the referenced SSCs should have been included in Table 3-9. BNI committed that the ISM process will identify all RRC SSCs and any changes to the list of identified RRC SSCs will be reflected in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment to be acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazards and accident analysis results documented in the HLW PSAR and would not be expected to result in significant changes to the facility design or safety conclusions.

[122] HCP - HLW Concentrate Receipt Process System, HFP - HLW Melter Feed Process System, and RLD – radioactive liquid disposal.

Reviewers also questioned (Questions HLW-PSAR-170 and -213) whether sumps in the reagent tank room met the definition of RRC SSCs. In response, BNI committed to identify these sumps as RRC SSCs. The sumps collect and recover spills of potentially reactive chemicals. The designation of the sumps as RRC SSCs is consistent with the approved definition of RRC. As indicated above, BNI committed to use its ISM process to evaluate RRC SSCs by December 31, 2002, and to revise the list of RRCs in the first revision thereafter. On this basis, the reviewers found the BNI response acceptable. During the DOE review of the HLW PSAR, BNI submitted 24590-WTP-ABCN-ESH-02-027, proposing to modify the HLW design by (1) adding piping loops to each HLW concentrate receipt vessel to allow for the potential future installation of transfer devices in the event of failure of all installed reverse flow diverters in any vessel and (2) replacing the pour tunnel bogie interlock loop with a drip tray for each melter pour spout to prevent glass spills due to an inadvertent pour when a canister is not is place under a pour spout. Portions of the spare piping loops that penetrate the wet process cell wall would be located within shielded wall bulges and would involve coaxial piping (i.e., pipe in pipe) to provide for containment of HLW waste. The results of the DOE review and conditional acceptance of these HLW design changes was documented in an SER transmitted to BNI by letter 03-OSR-0076,[123] dated March 17, 2003. The SER identified seven conditions of acceptance for the ABCN; these conditions of acceptance are listed in Section 4.2.3.3.

2. **Safety Function –** The reviewers found the description of the safety functions of SSCs designated SDC and SDS as described in PSAR Chapter 4 to be conditionally acceptable. The chapter included a section that described the credited safety function for each SDC and SDS SSC identified. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," requires that the PSAR contain a "description of facility systems, structures, and components including those designated as important to safety."

   Reviewers asked several questions (HLW-PSAR-105, -171, -176, -177 and -179) pertaining to the adequacy of the shield walls for conforming to the WTP radiation dose standards. DOE/RL-96-0003 requires that the PSAR include an "analysis of radiological, nuclear, and process hazards for the design," and a "description of facility features and functions provided to control the radiological, nuclear, and process hazards." BNI's responses indicated that both the Microshield computer program and Monte Carlo N-Particle codes were used to derive required shielding thickness to ensure that SRD Safety Criterion 2.0-1 was met. BNI cited supporting calculation reports 24590-HLW-Z0C-30-00006, *Bulk Shielding Requirements for High Level Waste Facility*; CALC-W375HV-NS0008, *Bulk Shielding Assessment for HLW Vitrification Building*; and 24590-HLW-Z0C-30-00008, *HLW Penetrations*. From review of these and other supporting calculations and documents, the reviewers concluded that the HLW facility shielding design calculations were conducted conservatively and the calculated external occupational doses from normal operation were well below the relevant standards.

[123] 03-OSR-0076, ORP letter, R. F. Schepens to R. J. Naventi, BNI, "Approval of Authorization Basis Change Notice (ABCN) 24590-WTP-ABCN-ESH-02-027, Revision 0, to the High Level Waste (HLW) Preliminary Safety Analysis Report (PSAR)," dated March 17, 2003.

Some information in the PSAR concerning safety functions was incorrect, or incomplete, and required revision. BNI committed in its question responses to include correct information in the first PSAR revision following authorization for full facility construction. This information is as follows:

(a) The reviewers identified several inconsistencies and deficiencies for the safety functions of high-high level interlocks. To meet the requirements of SRD Safety Criterion 1.0-8; the SRD Appendix A, Sections 5.0, "Development of Control Strategies," and 6.0, "Classification of Structures, Systems, and Components"; and the SRD Appendix B, Table 1; and in responses to Questions HLW-PSAR-051, -098, -189, and -190, BNI committed to several changes in the safety functions of high-high level interlocks. These functions include preventing vessel overflow and protecting the headspace assumptions.

(b) To fully satisfy the requirements of SRD Safety Criterion 3.1-1 and in response to Question HLW-PSAR-120, BNI committed to revise PSAR Section 2.9.7 to include a statement that the instrument air is dry, oil-free, and compressed to 125 psig.

(c) The reviewers questioned (Question HLW-PSAR-184) whether some of the SSCs used to prevent hydrogen accumulation in the vessels satisfied the single-failure criteria of the SRD, Appendix A, Section 5.0. In response, BNI committed to revise the PSAR description of the hydrogen mitigation system single-failure features as follows:

- Piping and instrumentation diagrams HLW-M6-RLD-00007 (purge air) will be revised to include testable check valves downstream of ITS control valves on each feed stream to prevent any backflow in the event of loss of line pressure.

- The location of pressure transmitters PT/3016 and PT/3013 (which isolate the normal HLW plant service air supply by closing valves YV 3006 and YV 3014 [double shutoff] in the event of loss of supply from BOF) will be revised on piping and instrumentation 24590-HLW-M6-PSA-00003, *P&ID – HLW Plant Service Air System Plant Service Air Distribution (Q)*, before the plant service air receivers.

(d) The reviewers questioned (Question HLW-PSAR-228) how the dynamic wind effects were incorporated into the design of the C5 HVAC system to meet the requirements of SRD Safety Criterion 4.1-5. In response, BNI committed to revise the PSAR description of the C5 system negative pressure control as follows: "The HVAC control systems will include features that will consider wind effects in a manner to provide stable operation to maintain negative pressure and this information will be included in the PSAR in the first revision."

(e) The reviewers found discrepancies (Question HLW-PSAR-229) between the requirements of the smoke/fire dampers credited in SCR-HVENT/N0002

(CSD-HHLW/N0022) and their seismic classification as SC-II provided in PSAR, Section 3, Table 3-10. In Question HLW-PSAR-229, reviewers asked how these dampers could be credited for mitigating fire propagation by isolation of the fire affected areas during and following the seismic event. The SC-II classification allows for inelastic energy absorption that could change the shape of the frame, possibly preventing closure of the dampers. In response, BNI committed to revise Table 3-10 and provided the following clarification: "The seismic classification of the smoke/fire dampers credited in SCR-HVENT/N0002 (CSD-HHLW/N0022) is SC-I. Please note that HLW PSAR, Table 3-10, Seismic Category of HLW SSCs, page 3-211, indicates that the inbleed filter units are SC-II. This table will be revised to indicate that the smoke/fire dampers associated with inbleeds will be SC-I."

The reviewers found these commitments acceptable. Although HLW PSAR Table 3-9 was not consistent with Appendix A and may also be expanded as a result of ISM Cycle III hazard analysis, the reviewers found the safety functions of those SSCs designated as RRC in Table 3-9 of the HLW PSAR to be acceptable.

3. **System Description –** The reviewers found the system descriptions of SSCs designated SDC and SDS to be acceptable, as described in PSAR Chapter 4. The chapter included a section that described each SDC and SDS SSC identified. The reviewers found the descriptions to be complete and adequate. The reviewers concluded that the system descriptions for SDC and SDS SSCs were consistent with the requirements of the SRD.

   In accordance with the approved version of 24590-WTP-ABCN-ESH-01-029, system descriptions for RRC SSCs are not required in the PSAR. This was acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazard and accident results documented in the HLW PSAR and detailed descriptions of RRC SSCs are not required to adequately document the facility safety basis.

4. **Functional Requirements** – The reviewers found the functional requirements of SSCs designated SDC and SDS to be conditionally acceptable, as described in PSAR Chapter 4. For each SDC and SDS SSC identified, the chapter included a section that described the functional requirements of the SSC.

   Some information on the functional requirements for ITS SSCs in the PSAR was incomplete, or inaccurate, and BNI committed in its question responses to correct the information, in the first PSAR revision following authorization for full facility construction. This information is as follows:

   (a) In response to Question HLW-PSAR-023, which questioned the blinding of the HEPA filters because of the failure of the preheaters, BNI stated that the capacity of the HEPA filter preheaters was increased to add conservatism in ensuring that the HEPA filters operated at temperatures above the dew point temperature of the offgas stream. The reviewers accepted this response because it clarified the

ability of the melter offgas system to safely accommodate postulated off-normal conditions.

(b) In Question HLW-PSAR-058, reviewers asked for the basis for ensuring the assumed failure rate of the canister handling crane and grapple. BNI's response provided a basis for crane and grapple failure rates and stated that including advantages that can be reasonably credited for use of a high integrity crane, with prescribed maintenance, testing, and inspection protocols consistent with the desired degree of reliability, a failure rate of 10^{-6} per lift, was acceptable. BNI stated that the high integrity crane is not single-failure proof and that the assumed failure rate of the high integrity industrial crane used in WTP is 3×10^{-6}. BNI also stated that grapple design will be such that the grapple reliability will be equal to that of a crane. The reviewers found this information acceptable because it clarified the failure rates of the canister handling crane and grapple.

(c) In Question HLW-PSAR-059, reviewers asked for the functional requirements of the immobilized HLW cask to ensure that it will withstand the highest drop from the most limiting configuration in the HLW facility. In response, BNI provided additional information on the cask design and functional requirements that was not included in the PSAR. The reviewers found the information acceptable because it clarified the functional requirements of the immobilized cask for this situation.

(d) In response to Question HLW-PSAR-099 requesting the functional requirements for the SDC impact absorbers, BNI provided additional information on the performance requirements for the impact absorbers, which were designed to absorb the energy from a dropped immobilized HLW canister or cask. Reviewers found the information acceptable because it clarified the functional requirements of the impact absorber.

Although HLW PSAR Table 3-9 was not consistent with Appendix A and may also be expanded as a result of ISM Cycle III hazard analysis, the reviewers found the functional requirements for those SSCs designated as RRC in Table 3-9 of the HLW PSAR to be acceptable.

5. **Systems Evaluation** – The reviewers found the system evaluations of SSCs designated SDC and SDS to be acceptable, as described in PSAR Chapter 4. For each SDC and SDS SSC identified, the chapter included a section that evaluated the functional requirements versus the proposed design information for the SSC and integrated safety systems. The reviewers found the evaluations to be complete and adequate. The reviewers concluded that the system evaluations for SDC and SDS SSC were consistent with the requirements of the SRD.

In accordance with the approved version of 24590-WTP-ABCN-ESH-01-029, system evaluations for RRC SSCs are not required in the PSAR. This was acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazard and accident results documented in the HLW PSAR and

detailed descriptions of RRC SSCs are not required to adequately document the facility safety basis.

6. **Controls (TSRs) –** Section 4.2.4 of this SER addresses the adequacy of the draft TSRs provided in the HLW PSAR. The reviewers evaluated the adequacy of the TSRs for ITS SSCs even though only the draft TSRs were required at this time. The reviewers ensured the SSCs identified that required TSRs were adequately addressed in the HLW PSAR. The reviewers found the draft TSRs were consistent with the identification of ITS SSCs and appropriate for the controls identified and therefore were acceptable.

4.2.3.3 Conclusions

The reviewers concluded that the description of ITS SSCs in the HLW PSAR was conditionally acceptable. The reviewers found that, except as discussed below, the SDC and SDS SSCs, including their safety functions, system descriptions, functional requirements, system evaluations, and controls (draft TSRs) were complete and adequate. Except as noted, the reviewers found that the HLW PSAR identified and described all ITS SSCs designated as RRC.

Conditions of Acceptance – BNI committed to complete the following in the first revision of the HLW PSAR following the authorization for full HLW facility construction:

1. Include a complete list of RRC SSCs, with associated safety functions, as committed to in responses to Questions HLW-PSAR-039, -170, -213, -250, -251, and -252. (See Section 4.2.3.2, Item 1.)

2. Update the HLW PSAR to clarify the inclusion of ITS purge air into the spare process lines (concentrate receipt vessel stub out lines), as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

3. Delete the ABCN proposed addition to HLW PSAR Section 3.4.1.1.2.6, which read, "Subsequent failure of the secondary pipe, should the primary pipe leak, is not eminent (sic) within a reasonable time frame for detection of the primary pipe leak via the cell leak detection system," as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

4. Perform a confirmatory calculation or other documentation that shows that the design of the melter pour spout drip tray accomplishes the bulk confinement of inadvertent melter pours based on melter experience with similar designs and document the results in the HLW PSAR, as committed to in discussions with DOE. (See Section 4.2.3.2, Item 1.)

5. Revise the appropriate section of Table 4-1 to identify the SDC bulge and SDC lines (primary and secondary) to be consistent with the ABCN text descriptions, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

6. Revise the PSAR to state that the secondary piping of the concentrate receipt vessel coaxial containment piping will be routed to the wet process cell, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

7. Add the slope requirement for the coaxial containment/spare process piping as an explicit design feature in HLW PSAR Sections 4.3.7.6 and 5.6.2, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

8. Revise HLW PSAR Section 5.5 to include draft limiting conditions of operation and surveillance requirements for the melter pour spout drip tray, as committed to in discussions with DOE. (See Section 4.2.3.2, Item 1.)

9. Correct the information in the PSAR on the safety functions of the high-high level interlocks, quality of instrument air, design of the hydrogen mitigation system to meet the single-failure criteria of the SRD, Appendix A, the design of the C5 ventilation system for wind effects, and the seismic qualification (SC-I) of the smoke/fire dampers. This was committed to in responses to Questions HLW-PSAR-051, -098, -120, -184, -189, -190, -228, and -229. (See Section 4.2.3.2, Item 2.)

10. Correct the information in the PSAR on the functional requirements for the canister handling crane and grapple, immobilized HLW cask, impact absorbers, and HEPA filter preheaters, as committed to in responses to Questions HLW-PSAR-023, -058, -059, and -099. (See Section 4.2.3.2, Item 4.)

4.2.4 HLW Facility TSRs

The purpose of this review was to determine whether the submittal adequately described appropriate draft TSRs for the hazard control provisions and strategies for the HLW facility according to the applicable requirements of the Contract. The review should also determine whether PSAR Volume IV adequately provided the basis for developing the TSRs to ensure that the facility will operate within the analyzed safety basis.

4.2.4.1 Requirements

SRD Safety Criterion 9.2-2 states, "Technical safety requirements shall be based on the FSAR and any facility-specific commitments made." The BNI Contract, Table S7-1, provides the requirement for submitting draft TSRs and states that draft TSRs will be submitted with the CAR. DOE/RL-96-0003, Section 4.3.2, Item A.18.c, requires that the PSAR requesting construction authorization include a draft of the TSRs. The SRD defined the content of the TSRs. SRD Safety Criterion 9.2-1 stated that TSRs shall be prepared and submitted for approval, and the facility shall be operated according to the approved TSRs. SRD Safety Criterion 9.2-3 described the standard for TSRs, consisting of safety limits (Item 1) and limited control settings (Item 2a), each of which was further defined in the SRD. Finally, SRD Safety Criterion 9.2-4 stated that TSRs shall be kept current at all times so that they reflect the facility as it exists and as it is analyzed in the safety analysis report.

4.2.4.2 Evaluation

BNI's HLW submittal included draft TSRs that provided information commensurate with the current preliminary stage of facility design. These included limiting conditions of operation; associated surveillance requirements, mostly to be determined; administrative controls; bases, also mostly to be determined; and design features. The review of the draft TSRs was limited to evaluations to (1) confirm that safety functions derived in PSAR Section 3.4 were carried forward to form the basis for the TSR derivations in PSAR Chapter 5.0 and (2) confirm the consistency between Chapter 5.0 and the draft TSRs. The reviewers found that the draft TSRs demonstrated proper application of the process to ensure that "The radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, have been…*sufficiently controlled/mitigated* [emphasis added]…to establish a basis for safe operation and an unambiguous definition of the safe-operating envelope." Specifically, limiting conditions of operation and surveillance requirements were identified to protect the active safety functions of ITS SSCs; design features were identified to protect passive safety functions by maintaining the configurations assumed in the hazard and accident analyses; and administrative controls were defined to describe safety management programs. As noted in Section 3.5 of this SER, the reviewers found the draft TSRs acceptable. Detailed review leading to approval of TSRs will be performed along with the review of the FSAR before facility operation is authorized.

4.2.4.3 Conclusions

The reviewers concluded that the draft TSRs provided with the HLW PSAR were commensurate with the preliminary design and were acceptable for full HLW facility construction authorization.

4.3 Pretreatment Facility

The scope of PT activities covered in the PSAR, Volume II, *PT Facility Specific Information*, is the full construction of the PT facility, systems, and processes.

4.3.1 PT Facility Description

The purpose of this review was to determine whether the PSAR adequately described the PT facility and processes encompassed by the PSAR. This review addressed facility and process descriptions that could affect safety functions, hazards, or potential accidents (at the completed facility) and their consequences. Examples of facility features are location, facility design information, and the location and arrangement of buildings on the facility site. Examples of process features are the general arrangement, function, and operation of major components of the processes for pretreating waste.

4.3.1.1 Requirements

The requirements for the PT facility and process descriptions were parallel to the review criteria listed in Sections 3.2.1 and 4.1.1.1 of this SER but as applied to the PT facility and processes. The requirements for facility and process descriptions are outlined separately below.

Facility Description – For the PT facility, the facility description elements evaluated in the review included (1) facility location, (2) facility site's layout and location of buildings, (3) the facility's ability to resist failures of ITS SSCs, (4) imposed design limits for quantifying the structural behavior of the concrete and steel structures, (5) design and analysis processes used for ITS structures, (6) ITS electrical systems and components, (7) ventilation and air cleaning systems and components, (8) protection of control room atmospheres, and (9) effluent stacks.

Process Description – For the PT facility, the process description elements evaluated in this review included (1) a general description of the process, (2) the general arrangement of the major components of the process, (3) a discussion of process design, (4) the operating ranges and limits for process variables, (5) process equipment layout, (6) process design-related codes and standards, (7) instrumentation and controls required for monitoring the process, (8) process systems for waste management, and (9) information on process safety.

4.3.1.2 Evaluation

The results of the reviewers' evaluation of facility and process descriptions for the PT facility are summarized separately below.

Facility Description – The reviewers found the facility description acceptably met five of the nine elements and conditionally met four elements. The reviewers evaluated PT facility-specific information, structural and seismic calculations, and procedures referenced in PSAR Volume II and responses to questions pertaining to the structural design and analysis of the PT facility. The evaluation of information for each review element is discussed below:

1. Information on PT facility location was discussed in Section 3.2.2 of this SER and was found to be acceptable because the information was adequate to perform the necessary safety evaluation and to define the design basis conditions for the PT facility.

2. The reviewers found acceptable the description of the general layout and location of the PT building showing its major structural features and describing the major processes that will be occurring in the PT facility. The facility description also provided information on the proximity of the PT building to other WTP buildings, other Hanford facilities, and nearby public facilities and byways. The level of detail provided was adequate for performing a review of preliminary safety analyses for the PT facility.

3. The reviewers found design information on the ability of the PT facility to resist failure due to credible internal and external events to be conditionally acceptable. As part of BNI's strategy for phased construction authorization, BNI requested early authorization of PT pits, tunnels, and basemat. The reviewers focused on structural design

methodology and standards for both early authorizations and full construction authorization. Reviewers also performed detailed review of completed structural design as part of the safety review for early construction authorization of the PT pits, tunnels, and basemat. Reviewers found BNI's structural design methodology and standards, as described in the PSAR and supporting documentation, to be acceptable as discussed in the following paragraphs. Reviewers found problems with implementation of methodology and standards for pits, tunnels, and basemat design. Five conditions of acceptance were documented in Revision 2 of this SER. Specifically, conditions are found in Items 3(b), 3(d), 3(f), and 3(g).

As part of the PSAR subsurface pits, tunnels, and basemat review for the PT facility, designs and calculations were reviewed and found conditionally acceptable. Above-grade concrete and steel superstructure design calculations were not completed for the PSAR; however, the structural design criteria were reviewed. The PSAR identified the PT facility structure as SDC and SC-I. The reviewers found design codes and standards for the SC-I PT building acceptable as presented in 24590-WTP-DC-ST-01-001. These criteria are consistent with SRD Safety Criterion 4.1-3 and implementing standards ACI 349-01, ANSI/AISC N690-94, and DOE-STD-1020-94. These criteria, developed for WTP facilities, provided the minimum criteria to ensure building structures are designed to withstand the effects of natural phenomena events postulated to occur during the life of the facility. The criteria also described the bases for the design and evaluation of ITS SSCs. Chapter 5 of 24590-WTP-DC-ST-01-001 detailed the SC-I building requirements for reinforced concrete, structural steel design, and masonry design. Load factors, load combinations, stability requirements, deflection, anchorage, and story drift requirements were also established. The evaluation included the following types of loads listed in RL/REG-99-05, Section 1.2.3.3, Item 3:

(a) **Loads Encountered during Preoperational Testing, Startup, and Shutdown** – The PSAR did not address loads that may be encountered during preoperational testing, startup, or shutdown. Reviewers questioned (Question PT-PSAR-245) how startup loads were considered in designing the PT facility. In response, BNI stated that testing, startup, or shutdown loads for the PT facility were lower than those applied for the inertial effects of equipment in the seismic load cases. Even though BNI did not provide a numerical comparison in support of this assessment, the reviewers found this assessment reasonable and acceptable for the structural design of the PT facility.

(b) **Loads Encountered During Normal Operation** – The reviewers found conditionally acceptable the information on the following loads that could be encountered during normal operation: dead load, live load, snow load, ashfall load, wind load, pipe loads, thermal loads, and lateral earth pressure loads. BNI calculation report 24590-PTF-S0C-S15T-00011, *PT Facility Design Load Input for Structural Analysis*, adequately defined the normal operating loads for the PT facility. Some of these loads, such as floor live load, roof live load, and snow load, were defined quantitatively, while others had only the basis for selection described. Reviewers questioned (Questions PT-PSAR-225 and -226) what methods were used to incorporate loads caused by temperature differentials across PT walls and floor slabs. In response, BNI stated that both types of thermal loads

(i.e., loads due to uniform thermal growth and through-thickness thermal gradients) would be incorporated in determining structural design parameters (e.g., shear and moment). Bulk temperatures (average temperature in a wall or floor) will be modeled in GTSTRUDL, and moments and forces due to thermal growth will be obtained. Moments due to through-thickness thermal gradients will be calculated assuming that the walls are fully restrained on all four sides and assuming cracked section properties. Both resulting loads will be included in the design and code check for the structure. Reviewers found the response acceptable. Inclusion of loads due to bulk temperatures and through-thickness thermal gradients satisfied requirements of SRD Safety Criterion 4.1-3 implementing standard ACI 349-01. (However, see Section 4.3.1.2, Item 3[g] for discussion of load combinations and BNI's commitment for inclusion of thermal load in load combinations.)

As part of the review of the final design of pits, tunnels, and basemat for early construction authorization, reviewers found demand/capacity ratios to demonstrate compliance with ACI 349-01 to be conditionally acceptable. Reviewers questioned (Question PT-PSAR-227) what the demand/capacity ratios for critical locations broken down by types of load (i.e., dead load, live load, seismic load, and thermal load) were. In response, BNI committed to provide a structural design evaluation summary table. In that table, the demand (D) and the capacity (C) of the walls and the slabs of the pits and tunnels at several critical locations (at least one for each wall and slab) would be evaluated for the most critical load combination. BNI also would tabulate (a) the contribution of various loads (e.g., dead load, live load, seismic, thermal growth, and thermal through-thickness gradient) to the critical design parameters of interest (e.g., in-plane shear in the direction of the length of the walls, out-of-plane bending of the walls and the slabs, and out-of-plane shear in the walls and the slabs); (b) total demand, D, used in the actual design for each design parameter of interest; (c) code capacities of the critical sections for each design parameter of interest; and (d) the demand/capacity ratio for each design parameter of interest. The response to Question PT-PSAR-227 also committed to include uniform thermal growth and through-thickness thermal gradients in the structural design evaluation summary. These commitments were identified as the first condition of acceptance in Section 4.3.1.3 of Revision 2 of this SER. Subsequently, BNI issued CCN: 044586[124] to provide the documentation required to close this condition. Reviewers found the demand/capacity ratios and seismic margins in Tables 1, 2, 3, and 4 of CCN: 044586 acceptable. The information demonstrated adequate margin and met the requirements of ACI 349-01, the implementing standard required by the SRD Safety Criterion 4.1-3. This condition is closed.

(c) **Construction Loads** – The reviewers found the information on construction loads acceptable. While the PSAR did not specifically address construction loads,

[124] CCN: 044586, BNI Internal Memo, from I. Ghosh, to D. Houghton, "Response to Additional Information, Requested by OSR, in Relation to the Structural Evaluation of the Pretreatment Below-Grade Pits and Tunnels, and Basemat," dated November 19, 2002.

PSAR Section 2.4.3.14 stated that surcharge loading due to adjacent crane loading would be evaluated on below-grade structures. Specific crane loadings will be evaluated if they exceed the uniform 250 lb/ft^2 surcharge loading. Construction loads are specified in 24590-WTP-DC-ST-01-001, Section 4.15, for steel deck, structural framing, and structures when crane loading is adjacent to below-grade structures. Reviewers found the approach to structural analysis of construction loads acceptable because it was consistent with requirements of SRD Safety Criterion 4.1-3 implementing standard ACI 349-01.

(d) **Loads to be Sustained During Severe and Extreme Environmental Conditions** – The reviewers found conditionally acceptable information on the definition of the following loads that could result from severe and extreme environmental conditions and from external DBEs: extreme wind load, design basis earthquake load, extreme flood load, and extreme wind-generated missile impact load. The information was consistent with Table 4-1 of SRD Safety Criterion 4.1-3, the applicable criterion for an SDC SSC such as the PT structure. Complementing 24590-WTP-DC-ST-01-001, BNI presented methods to calculate earthquake loads in 24590-WTP-RPT-ST-01-002. This document provided dynamic and static analysis methods for SC-I and -II buildings and other SSCs required to withstand the effects of earthquakes without significant damage or loss of the safety function. The analysis criteria addressed development of design response spectra and associated input time histories, SSI modeling and analysis, and generation of seismic loads and in-structure response spectra. Section 7.2 of 24590-WTP-RPT-ST-01-002 detailed the method of analysis, seismic input motion, dynamic soil properties, SSI foundation modeling, and use of the SASSI computer program for solving SSI problems with embedded flexible foundations. The reviewers found that 24590-WTP-RPT-ST-01-002 met the seismic requirements of DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-3. The reviewers found this methodology acceptable.

In PSAR Volume I, Section 2.4.5.3, BNI committed to perform seismic analysis of the PT building considering the effects of SSI. This approach was consistent with the requirements SRD Safety Criterion 4.1-3 and implementing standard DOE-STD-1020-94. Design of the above-grade structures will be performed using an equivalent static analysis and the results of the SSI analysis, based on the final facility arrangement. Reviewers found this acceptable.

As part of the review of the final design of pits, tunnels, and basemat for early construction authorization, reviewers found the use of the SSI analysis as required by implementing standard DOE-STD-1020-94 conditionally acceptable. For PT facility pits, tunnels, and basemat, BNI performed a seismic SSI analysis based on a preliminary layout of walls using SASSI. Hereafter, this SSI analysis will be referred to as the preliminary SSI analysis. The analysis determined in-plane shear forces in the walls of subsurface pits and tunnels but not the lateral dynamic soil pressure. Reviewers questioned (Question PT-PSAR-224) how lateral soil pressures from seismic motion were calculated and how accurate the methods used to calculate the soil pressures were. In response, BNI stated that the

methodology for subsurface pits and tunnels wall design is described in CCN 041722[125] (see the following paragraph for further discussion). Also, in response to Question PT-PSAR-227, BNI committed to perform a revised seismic SSI analysis based on the revised building layout in which lateral dynamic soil pressure would be calculated directly for a few critical subsurface walls using soil pressure elements in the SASSI model. Hereafter, this SSI analysis will be referred to as the revised SSI analysis. If soil pressure is not obtained directly from the revised SSI analysis, the SASSI-generated moment results will be used to estimate the lateral dynamic soil pressure. BNI committed to provide this revised SSI analysis for DOE review before full PT facility construction authorization. This information would confirm the subsurface pits and tunnels design established using the process described in CCN: 041722. This condition was identified as a condition of acceptance in Section 4.3.1.3 of Revision 2 of this SER.

In the safety evaluation for the HLW and LAW buildings (Revision 2 of this SER), reviewers found the analysis of shears and moments for the pits, tunnels, and basemat design conditionally acceptable. To ensure that the design basis shears and moments would be conservative compared with those from subsequent SSI analysis, BNI developed a method in which the seismic design of the pits, tunnels, and basemat would be based on the absolute sum of two seismic load cases unless the design loads envelope the preliminary SSI-generated loads. One load case would be for the inertia loads of the superstructure including the basemat (based on 1.5 times the peak spectral acceleration of the ground motion) and the other for the lateral soil pressure on the walls of subsurface pits and tunnels (based on the ASCE 4-98 method). BNI's method was described in CCN: 041722, which was provided in the response to Question PT-PSAR-224. After this method was developed, BNI compared in-plane and out-of-plane shear forces in the walls of pits and tunnels and demonstrated that the method predicted conservative wall shears and moments compared with those from the preliminary SSI analysis. The reviewers agreed with BNI's conclusion. However, the revised SSI analyses (based on the revised building layout) had not been completed, without which the structural design adequacy could not be established as required by SRD Safety Criterion 4.1-3 implementing standard DOE-STD-1020-94. As a result, the reviewers requested the following supporting information as part of the process to resolve the issues raised in Questions PT-PSAR-224 and -227:

- From the preliminary SSI analysis results, for each wall and horizontal seismic motion, a tabulation of (a) the in-plane shear force in the direction of the length of the wall, (b) the maximum in-plane shear stress in the direction of the length of the wall, and (c) maximum out-of-plane bending moments, one about the horizontal axis and one about the vertical axis.

- A comparison of the out-of-plane bending moments in the subsurface walls from the preliminary SSI analysis for horizontal seismic motions

[125] CCN: 041722, BNI internal memo, I. Ghosh/M. Axup, to D. Houghton, "Methodology for Below Grade Pits and Tunnels Wall Design (Revised)," dated September 16, 2002.

with those from the GTSTRUDL analysis of the PT building. The applied dynamic soil pressure is based on ASCE 4-98.

This was identified as the second condition of acceptance in Section 4.3.1.3 of Revision 2 of this SER. Subsequently, BNI issued CCN: 044586[126] documenting the above information. Reviewers found the comparison between SSI and GTSTRUDL in Tables A, B, C, D, and E of CCN: 044586 acceptable. The comparison demonstrated the soil pressure used in the design was adequate as required by ASCE-4, the implementing standard required by SRD Safety Criterion 4.1-3. BNI demonstrated that for a few cases, where GTSTRUDL did not envelope preliminary SSI results, sufficient design margin exists to demonstrate that the design for pits, tunnels, and basemat was adequate. This condition is closed.

BNI provided a draft of the revised SSI analysis to ORP on December 13, 2002, and associated response spectra on December 31, 2002, in the following calculation reports:

- 24590-PTF-S0C-S15T-00002, *Pretreatment Facility (PTF) – Structural Model for SSI Analysis* (draft)
- 24590-PTF-S0C-S15T-00003, *Pretreatment Building Seismic Analysis: SSI Analysis* (draft)
- 24590-PTF-S0C-S15T-00004, *Pretreatment Building Seismic Analysis: Seismic Loads* (draft)
- 24590-PTF-S0C-S15T-00005, *Seismic Analysis of Pretreatment Building – In-Structure Response Spectra* (draft).

In the revised SSI analysis, BNI included soil elements on four surfaces of the main pit of the PT structure. Analysis results showed that the soil pressures from the SSI analysis were enveloped by the dynamic soil pressures applied in the GTSTRUDL analysis. However, this was not demonstrated for the fire-water pit. Reviewers asked (Question PT-PSAR-342) how the dynamic soil loads on the fire-water pit in the GTSTUDL analysis were shown to be conservative and how the effects of accidental torsion were included with respect to soil pressures. In response, BNI issued CCN: 052558,[127] which included a comparison of forces and moments from the revised SSI analysis with the seismic forces and moments from the GTSTRUDL analysis. The forces and moments from the revised SSI analysis were increased by 20% to account for the effects of accidental torsion.

[126] CCN: 044586, BNI Internal Memo, from I. Ghosh, to D. Houghton, "Response to Additional Information, Requested by OSR, in Relation to the Structural Evaluation of the Pretreatment Below-Grade Pits and Tunnels, and Basemat," dated November 19, 2002.
[127] CCN 052558, BNI internal memo, M. Scott, to B. Spezialetti, "Response to PT-PSAR-342," dated March 5, 2003.

The comparison demonstrated that the design for the pits and tunnels used loads that envelope the revised SSI loads and are therefore acceptable. In response, BNI also clarified what factors were applied to the basic results from the revised SSI analysis to develop design accelerations. A 20% increase was applied to all accelerations to account for the effects of averaging accelerations across an entire elevation. Increases were calculated on each above-ground floor to account for accidental torsion. These increases ranged from 5% to 20%, depending on direction and elevation. Reviewers found the additional information consistent with the requirements of ASCE-4 and ACE-349 and therefore acceptable.

In Question PT-PSAR-342, reviewers asked how the disconnect between the grid pattern of the walls and basemat element in the revised SSI model affected the results. The change in grid pattern resulted in only every other node being common between the wall and the basemat, which can introduce additional flexibility and not capture full load transfer. In response, BNI stated that because of the high stiffness of the basemat, the results were not affected and demonstrated that the accelerations were consistent between nodes that were common to the wall and basemat and nodes that were included in the basemat only. Reviewers found this justification of the modeling technique acceptable.

In developing in-structure response spectra, BNI used two springs connected to a common mass for each oscillator included in the revised SSI model. This is not a conventional method for modeling oscillators. Reviewers asked (Question PT-PSAR-342) why this methodology was acceptable and how the inclusion of oscillators with large masses affected the overall behavior of the structure. In response, BNI stated that the total mass of the model was not affected by adding oscillators because the equivalent mass was removed from the original model. BNI also noted that the springs added extra floor stiffness to the dynamic model but that the added stiffness is small compared with the stiffness of the walls to which the springs are attached. Reviewers found this method for modeling acceptable.

The response to Question PT-PSAR-342 was received on March 7, 2003.[128] Based on the results in the response, the condition referenced above is closed.

Reviewers found the modeling of the pits, tunnels, and basemat conditionally acceptable. BNI's GTSTRUDL model represented the wall and slab panels with as few as two finite elements in one direction. Such coarse modeling may result in nonconservative design moments and shear forces and could require modifying the GTSTRUDL predicted moments and shear forces. Reviewers questioned (Question PT-PSAR-231) how the effect of coarse analytical modeling was accounted for in the design with respect to global loads and local effects of openings, cutouts, and other discontinuities. In response to Question PT-PSAR-231, BNI committed to modify the design moments and shear forces in

[128] CCN: 051760, BNI letter, R. F. Naventi to R. J. Schepens, ORP, "Closeout Comment/Response on Pretreatment Construction Authorization Request," dated March 7, 2003.

calculation report 24590-PTF-DGC-S13T-00002, *Design of Pits, Foundation and Below Grade Walls for PT Building*, if required, using a method similar to that used in the HLW facility design. The impact from coarse modeling would be described in the structural design evaluation summary committed to be provided in the response to Question PT-PSAR-227. This was identified as the third condition of acceptance in Section 4.3.1.3 in Revision 2 of this SER. Subsequently, BNI issued CCN: 044586[129] documenting the above information to close this condition. Reviewers found the methodology used in the modeling of the pits, tunnels, and basemat acceptable as presented in Attachment B, Item 4, of CCN: 044586. The methodology used in revised calculation report 24590-PTF-DGC-S13T-00002, Rev. 1, accounted for potential inaccuracies in computing forces and moments in wall-to-slab junctions. Reviewers found the revised calculation acceptable. This condition is closed.

(e) **Loads Resulting from Abnormal Plant Conditions** – The PSAR did not specifically address loads designated as "abnormal plant condition loads." These have been included or enveloped under loads resulting from accident conditions. The reviewers found this to be acceptable because the PT facility structural design accounted for loads from all credible accident scenarios postulated in the facility hazard and accident analysis.

(f) **Loads Resulting from Accident Conditions** – Section 4.3.2 of this SER discussed identification and definition of the scenarios involving internal and external DBEs. A subset of these scenarios involved the potential for imposing significant loads on the PT structure, including drops of heavy objects and aircraft impact to the PT structure. The reviewers concluded that the treatment of loads resulting from accident conditions was conditionally acceptable, as described below:

(i) Section 4.3.2 of this SER addresses evaluation of the selection of the locations of load drops. Calculation report 24590-PTF-DBC-S15T-00001, *Structural Drop Load Analysis for PT Building*, performed a structural evaluation of drops. The analysis of load drops demonstrated that the facility design met the requirements for impactive loads as defined in SRD Safety Criterion 4.1-3 implementing standard ACI 349-01, Appendix C. Reviewers questioned (Question PT-PSAR-230) whether the design criteria for impact loads in ACI 349-01 were consistent with the safety functions of secondary containment and confinement. In response, BNI stated that damage resulting from a load drop would not result in catastrophic release of radioactive material because cracks would be small and provide a tortuous path. BNI also stated that any leak through the basemat would be to the soil column. Leakage to the soil below the facility would not result in radiation exposure to the facility worker, co-

[129] CCN: 044586, BNI Internal Memo, from I. Ghosh, to D. Houghton, "Response to Additional Information, Requested by OSR, in Relation to the Structural Evaluation of the Pretreatment Below-Grade Pits and Tunnels, and Basemat," dated November 19, 2002.

located worker, or the public.

No load drops were evaluated for the pits and tunnels slabs. In the PT facility design, no lifting devices were included that can lift a load above the tunnel floor slabs, and the pit floor slabs are protected from drops by pit covers. Reviewers questioned (Question PT-PSAR-013) the basis for not considering drops to the pit floor. In response, BNI stated that the probability of a drop of a heavy object over the openings above the pit was beyond extremely unlikely because only a few lifts per year would be conducted over the pit cover access holes with sufficient mass to be of concern, and the open area over the pit is small relative to the area of the hot cell. BNI stated that administrative controls would be in place requiring procedures limiting crane travel to avoid pipe chases and pit cover jumper access holes. Based on the review of the load drop analysis, the reviewers found this acceptable.

(ii) No additional loads were applied to the PT facility for internal flooding. Reviewers questioned (Question PT-PSAR-245) the basis for not explicitly including internal flood loads in the pits and tunnels. In response, BNI stated that flooding loads were offset by external soil pressures in the subsurface pits and tunnels. For the basemat, flooding loads are covered by considering equipment loads with their associated fluids. A drainage system with flow to sumps and the ultimate overflow vessel prevent internal flooding to any significant depth on the basemat. These features also prevent flooding loads on walls above the basemat. The reviewers found this acceptable.

For the remaining portions of the structure, the reviewers questioned (Question PT-PSAR-256) whether flooding caused by extended, uncontrolled release of liquids, such as from a break in a fire water line, could result in floor and wall loadings in excess of design limits for rooms located above the basemat. In response, BNI committed to evaluate PT internal flooding as part of the common-cause/common-mode failure analysis during ISM Cycle III and to identify control strategies for internal flooding events, as necessary, to prevent unacceptable impacts to the safety function of the structure located above the basemat. Prior to construction of floors above the basemat, BNI committed to demonstrate, in the flooding assessment, the vulnerability to flooding from internal sources. Where vulnerabilities are detected, mitigation will be provided. In the response to PT-PSAR-256, BNI committed to provide this analysis to ORP for approval and document the results in the first PSAR revision following completion of the hazard analysis. Reviewers found this commitment acceptable because the design detail required for this analysis is not available in preliminary design documentation. The flooding hazard analysis will be completed when the required design information is available and approved by ORP before construction of impacted portions of the facility.

(iii) The PSAR did not identify hazards resulting in increased structural temperatures. Reviewers questioned (Question PT-PSAR-246) why the thermal conditions such as a spill of the ultrafilter feed vessel during heated caustic digestion at 190°F were not considered. Reviewers considered this the most severe thermal challenge to the basemat based on the processes used in the PT facility. In response to Question PT-PSAR-246, BNI stated that stresses to the basemat from a seismic event bound thermal stresses from spills of these fluids. The vessels in the PT facility containing fluids at elevated temperature are SC-I, and thermal stresses from a spill are not superimposed with a seismic event. Reviewers found this response acceptable.

Additionally, reviewers evaluated the thermal effects of steam ejector failure in the facility. ACI-349-01, Appendix A, "Thermal Considerations," permits surface temperatures up to 350°F for short-term periods and local areas up to 650°F from steam or water jets for pipe failure. Reviewers found the thermal effect of steam ejector failure acceptable because the high-pressure steam temperature used in the ejectors was below these ACI-349-01 accident temperature limits. (However, see also the description of the effect of steam leaks on HEPA filters, which is discussed in Section 4.3.3 of this SER.)

(iv) DOE-STD-3014-96 provides several screening methods to determine whether detailed analyses of aircraft impact on DOE facilities are warranted. Because this guidance was the most complete and coherent set of aircraft crash evaluation criteria available, it was used. These screening methods include determination of frequency of aircraft impact (using data on specific DOE facilities), structural analyses to determine the facility's ability to withstand the impact, probability of damage to ITS SSCs, and radiological exposure to the offsite public (to be compared with guidelines provided in the standard). BNI calculated unmitigated consequences to the offsite receptor given the occurrence of a crash and the failure of all vessels containing radioactive material. This screening, documented in Revision C of calculation report 24590-WTP-Z0C-50-00001, demonstrated that the unmitigated radiological consequences of an aircraft crash into the PT facility, 19 rem, were below the guideline value of 25 rem for which no structural analysis was necessary using the guidelines. Reviewers found the screening analysis and conclusion acceptable.

(g) **Load Combinations** – PSAR Volume I, Section 2.4.4.1.4.1, defined the applicable load combinations for reinforced concrete and structural steel design. As noted in Section 3.2.2 of this SER, the reviewers found the definition of these load combinations acceptable because they were consistent with the requirements of the SRD Safety Criterion 4.1-3 implementing codes and standards, the applicable criteria for the SDC structure. However, reviewers found BNI's design of subsurface pits and tunnels conditionally acceptable because it did not include all required load combinations in calculation report 24590-PTF-S0C-S15T-00012,

Structural Analysis for the Pretreatment Facility. In Questions PT-PSAR-225, -226, and -227, which dealt with treatment of thermal stress, reviewers questioned why load combinations did not include combinations that removed load components that could reduce the magnitude of stress due to other loads, such as thermal loads or reduced dead load, as required by ACI 349-01. In response to Question PT-PSAR-227, BNI committed to include both through-thickness thermal loads and thermal growth loads in design calculations, provide justification for not considering all load combinations, and provide this information for DOE review. This was identified as the fourth condition of acceptance in Section 4.3.1.3 of Revision 2 of this SER.

Subsequently, BNI issued CCN: 044586 addressing the above concerns. Reviewers found the discussion of through-wall thermal gradients as presented in Attachment B, Item 5, of CCN: 044586[130] acceptable because gradients in the pits, tunnels, and basemat did not exceed 40°F for normal operations. BNI provided a detailed list in CCN: 044586 of how the 18 individual load cases analyzed in GTSTRUDL combined in 444 combinations. Individual load cases included dead load, live load, four wind loads, three seismic inertial loads, one static and four dynamic soil loads, roof live load, snow load, ashfall load, and operational thermal load. A total of 444 combinations were required to ensure that all combinations identified in the PSAR were addressed. Seismic inertial loads and dynamic soil loads were combined such that the most conservative combinations possible were captured. Reviewers found this treatment of load combinations acceptable and consistent with requirements of ACI 349-01. This condition is closed.

4. Reviewers found the information on imposed design limits for quantifying the structural behavior of the concrete structures conditionally acceptable. Calculation report 24590-PTF-DGC-S13T-00002 and 24590-PTF-DGC-S13T-00003, *Design of Foundation Basemat for PT Building*, were reviewed to evaluate whether the PSAR used appropriate design limits and structural criteria. The reviewers also evaluated the method used to determine design basis moments, shears, and forces in the PT facility resulting from normal operating loads. The reviewers found the methods used in these calculations to be acceptable because they were consistent with the applicable requirements, including SRD Safety Criterion 4.1-3, implementing standard DOE STD-1020-94, and other applicable codes.

   The reviewers found acceptable the information on imposed design limits for quantifying the structural behavior of the embedments in the PT facility. To evaluate whether the PSAR referenced appropriate design limits and structural criteria, the calculations used for the subsurface pits, tunnels, and basemat embedments were evaluated: 24590-PTF-DDC-S13T-00001, *Design of Vessel Support Embeds at El. 0' and Below for PT Building*, 24590-PTF-DDC-S13T-00002, *Design of Anchor Bolts and Miscellaneous*

[130] CCN: 044586, BNI Internal Memo, from I. Ghosh, to D. Houghton, "Response to Additional Information, Requested by OSR, in Relation to the Structural Evaluation of the Pretreatment Below-Grade Pits and Tunnels, and Basemat," dated November 19, 2002.

Embedments at El. 0' and Below PT Building, and 24590-PTF-DGC-S13T-00003. The reviewers found that the methods used to determine demand and capacities were consistent with the applicable requirements, including SRD Safety Criterion 4.1-3 and implementing standard DOE STD-1020-94, and were therefore acceptable.

As part of the review of the final design of the pits, tunnels, and basemat for early construction authorization, reviewers found details regarding structural analysis methods conditionally acceptable. Calculation report 24590-PTF-DGC-S13T-00004, *Design of Dowels at El 0'-0" for Above Grade Shear Walls for PT Building*, was reviewed to evaluate the methodology for design of the dowels connecting the basemat to the above-grade walls. The calculation provided design information for portions of vertical reinforcement for the above-grade wall that extend into the basemat. Reviewers identified wall segments where shear forces appeared to exceed requirements of ACI 349-01, Section 21.6.5, "Shear Strength," in 24590-PTF-DGC-S13T-00004. These high shear forces are found in both north-south and east-west oriented walls. In the response to Question PT-PSAR-227, which asked for details regarding structural analysis methods, BNI committed to provide a reference to a previous code requirement interpretation for shear wall design limits to provide a basis for concluding that the shear forces were acceptable using ACI 349-01. This was identified as the fifth condition of acceptance in Section 4.3.1.3 of Revision 2 of this SER. Subsequently, BNI issued CCN: 044586[131] providing the interpretation to close this condition. Reviewers found the discussion of code interpretation for shear wall design limits presented in Attachment C of CCN: 044586 acceptable for pits, tunnels, and basemat. Reviewers consider that BNI's interpretation of shear wall design limits meets the requirements of ACI 349-01. This condition is closed.

5. The reviewers found the information on the structural design and analysis processes used for the PT facility to be acceptable. The method for validating and verifying structural and thermal analysis codes was acceptable because the design and analysis process conforms to the applicable SRD Safety Criterion 4.1-3 implementing standards, including the requirements specified in DOE-STD-1020-94, ASCE 4-98, and ACI 349-01.

6. The reviewers found the PSAR information on electrical systems and components to be conditionally acceptable. Factors that could affect potential accidents or their consequences were clearly documented in the PSAR. The PSAR described electrical systems and components that were ITS SSCs consistent with the preliminary facility and process design. Electrical systems and components required to mitigate DBEs were identified. SDC SSCs will be designed to Quality Level 1 requirements.

   The design basis described in the PSAR included the implementing electrical codes and standards identified in SRD Safety Criteria 4.1-2, 4.1-3, 4.1-5, 4.3-1 through 4.3-5, 4.4-2, 4.4-4, and 4.4-9 through 4.4-11. On that basis, the PSAR provided reasonable assurance that the fundamental elements of electrical distribution design will be provided, including

[131] CCN: 044586, BNI Internal Memo, from I. Ghosh, to D. Houghton, "Response to Additional Information, Requested by OSR, in Relation to the Structural Evaluation of the Pretreatment Below-Grade Pits and Tunnels, and Basemat," dated November 19, 2002.

features required for adequate functional performance, capacity, loading capability, redundancy, independence, voltage regulation, short circuit capability, electrical protection, controls, system layout, and grounding. PSAR Sections 2.8 and 4.3 addressed ITS electrical systems and components and provided information on electrical components and electrical system design relative to the ITS equipment that it supports. PSAR Figure 2A-67 presented the overall electrical single line diagram for the PT facility, and Figure 2A-68 presented the electrical single line diagram for the PT SDC UPS.

Reviewers found PT electrical design compliance with the single-failure criterion conditionally acceptable. Regarding conformance of the SDC UPS system to the single-failure criterion, the PSAR described the SDC C5 ventilation exhaust system as consisting of three 50% capacity centrifugal fans. BNI specified three 50% capacity trains for reliability, safety, and economics. This three-train C5 ventilation system was supported by three redundant and independent divisions (trains) of SDC AC motive power and by SDC instrumentation and control. However, the PSAR described only two independent and redundant divisions of SDC UPS instrument power. The reviewers questioned (Question PT-PSAR-205) how this UPS configuration could satisfy the single-failure criterion as required by SRD Safety Criteria 4.3-5 and 4.4-3 and implementing standard IEEE 379-1994, *Application of Single Failure Criterion to Nuclear Power Generating Station Safety Systems.* In response, BNI committed to provide one Plant Protection System division and one respective UPS power division for each redundant SDC division in the PT facility. For SDC three-train applications such as C5 ventilation, this would require three independent and redundant SDC UPS divisions, rather than two SDC UPS divisions as described in the PSAR. In the response to Question PT-PSAR-205, BNI committed to revise the PSAR to include the UPS configuration described above in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

Pursuant to SRD Safety Criterion 4.4-9, the batteries for the SDC UPS are required to be designed, specified, installed, maintained, and tested in accordance with IEEE 484-1996, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*, and IEEE 450-1995, *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*. The PSAR did not contain sufficient detail to determine whether these implementing standards would be followed. Reviewers questioned (Question PT-PSAR-209) if the SDC UPS would be designed to conform to these implementing standards. In response, BNI stated the SDC UPS would be designed to the above standards. The reviewers found this clarification acceptable.

SRD Safety Criteria 4.4-2 and 4.4-11 require that electric power systems designated as SDC shall be designed to ensure their operability under normal and accident conditions and qualified to function as intended under the environments they are expected to experience. The reviewers questioned (Question PT-PSAR-207) the potential for interaction of UPS loads with the quality of the UPS power. In response, BNI stated that IEEE 446-1995, *IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications*, would be applied for control of

harmonic distortion. BNI will provide the UPS supplier a load profile, including estimated future loads, and the maximum allowable total harmonic distortion. BNI also stated that SDC UPS systems would provide power to SDC and selected SDS loads. These loads will be separate from non-ITS loads in accordance with implementing standards IEEE 308-1991, *Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*, and IEEE 384-1992, *Standard Criteria for Independence of Class 1E Equipment and Circuits*. Loads that are not ITS and are not required to meet the separation requirements of IEEE 308-1991 and IEEE 384-1992 will be powered from non-ITS UPS systems. The reviewers found this response consistent with the SRD Safety Criterion 4.4-11 and acceptable for clarifying the design and operating basis of the SDC UPS.

7. The reviewers found the information on confinement ventilation exhaust systems for the PT facility, as discussed in PSAR Volume II, acceptable. The exhaust air cleaning and confinement barriers to protect facility and co-located workers, the public, and the environment conformed with applicable SRD Safety Criteria 4.4-5, 4.4-6, 4.4-7, and 4.4-8 and complied with implementing standard ASME AG-1.

8. The reviewers found the PSAR information on protecting control room atmospheres for PT conditionally acceptable. Further analysis of control and monitoring capabilities for HLW, LAW, and BOF ITS systems and protection from hazardous material releases, including transportation events, is required. Specific conditions of acceptance are documented in Sections 4.1, 4.2, and 4.4 of this SER as discussed below.

   PSAR Volume I stated that the LAW and HLW facility would be monitored from the PT facility main control room, designed to remain habitable for all credible events, and meet the requirements of SRD Safety Criterion 4.3-7. Sections 4.1.1.2, 4.2.1.2, and 4.4.1.2 of this SER describe reviewer questions regarding the need to provide control capability of ITS systems in LAW, HLW, and PT facilities. In response, BNI committed to provide dedicated and hardened control and monitoring capability for LAW, HLW, PT, and BOF facilities to achieve and maintain a safe state.

   BNI also committed to perform a detailed evaluation to further assess the impact of hazardous material releases, including transportation events, on the habitability in all WTP control rooms. BNI committed to provide initial information in the first revision of the PSAR following authorization for full facility construction and final information with the FSAR. This commitment is discussed in Sections 4.1.1.2, and 4.2.1.2 of this SER.

   The reviewers found the general C1 and main control room HVAC systems conditionally acceptable. The main control room HVAC system is isolated from the balance of its confinement zone and switches to a recirculating mode of operation, with redundant filter trains, upon detection of smoke or other contaminants. Air required to pressurize the control room is normally brought in from the outdoors. However, the final determination of the quality of the outdoor air, its monitoring and treatment, and alternate sources of air, are being re-evaluated as discussed in Sections 4.1.1.2 and 4.2.1.2 of this SER. The standby ventilation system has two 100% redundant fans with the backup fan on automatic start upon failure of the primary fan to start on an activation signal. The

charcoal, HEPA, and entire filter train will be designed and tested to applicable sections of ASME AG-1 as required by SRD Safety Criteria 4.4-6, 4.4-7, and 4.4-8.

9. Reviewers found the information on how the PT effluent stack was represented in structural and seismic modeling for the PT facility acceptable because the stack was appropriately included in the analytical model used for design and analysis as documented in calculation reports 24590-PTF-S0C-S15T-00002, *Pretreatment Facility (PTF) – Structural Model for SSI Analysis*, and 24590-PTF-S0C-S15T-00012. Reviewers noted that the detailed structural design of the stack was not completed, but this was acceptable because the stack's structural design loading was included in the PT building design.

Process Description – The reviewers found that the process description acceptably met five of the nine elements and conditionally met the other four elements. The evaluation of the information for each review criterion is summarized below:

1. The reviewers found conditionally acceptable the discussion of the basic theory of the PT process, the overview of the operating logic, process flow diagrams, process vessels, process systems, ion exchange columns, vessel vent and exhaust systems, radioactive waste handling and disposal, and the PT in-cell and filter handling systems. An overview of the process description for the PT facility was provided in PSAR Volume II, Section 2.5.1, along with Figure 2A-18. Additionally, piping and instrumentation drawings showing the major components and flow paths of the PT process were provided with PSAR Volume II, Figures 2A-20 through 2A-59. In the overview of the PT process, the reviewers found that sufficient information was provided on the process proposed for the PT facility to support understanding of the hazard and accident analyses and the selection of DBEs.

   However, in response to Question PT-PSAR-198, BNI stated that the caustic leaching process at elevated temperature, described in Section 2.5.1 of PSAR Volume II, has not been adequately addressed in the hazard and accident analysis even though caustic leaching at elevated temperature is required by Contract (see Section 4.3.2.2, Item 6, of this SER.) Capability to perform caustic leaching at elevated temperature was provided in the design. In response to Question PT-PSAR-198, BNI committed to revise the PSAR in the first revision following authorization for full facility construction to address this unit operation. Reviewers found this commitment acceptable because controls are expected to be the same as for the boiling DBE and the preventive control strategies could be revised, if necessary, before construction of the equipment features is required.

2. The reviewers found acceptable the general arrangement, function, and operation of major components for the process as described in PSAR Volume II, Section 2.5, because all major components had been addressed.

3. The reviewers found the process design, materials of construction, equipment design, process control logic, and control instrumentation to be acceptable and consistent with requirements of the SRD with the exception of information supporting material selection and allowances for erosion/corrosion. The reviewers found acceptable the process

equipment information, including piping and instrumentation diagrams, electrical design information, relief system design and design basis, ventilation system design, design codes and standards used, material and energy balances, and safety systems. Process equipment information in PSAR Sections 2.4, 2.5, 2.6, and 2.9 was also found to be acceptable.

However, information on the bases for corrosion/erosion allowances for process piping was not complete. The reviewers questioned (Question PT-PSAR-215) the basis for the corrosion allowance used for transfer pipes. In response, BNI provided information supporting the conclusion that corrosion rates are low for conditions found in the WTP, including those that will exist in the transfer lines. The expected uniform corrosion rates at WTP operating temperatures in specified nitric acid, water, and sodium hydroxide concentrations are <1 mpy (mil per year). To provide calculational consistency and conservatism, the expected uniform corrosion rate is assumed to be 1 mpy. BNI provided references documenting its basis for concluding that the minimum recommended erosion allowance for piping with high solids content slurries is about 80 mil. In response to Question PT-PSAR-215, BNI stated that most of the insoluble sludge is fine grained and tends to be soft. As a basis for this, BNI provided reference to work performed at Battelle,[132] which suggests tank waste solids have the hardness of talc and are relatively soft. According to Schumacher,[133] nearly all the Hanford waste is expected to be less than or about 1 micrometer in diameter, with fewer than 1% of the particles >5 micrometers in diameter. As a consequence, little erosion is expected.

Erosion potential is greater in the HLW and LAW facilities due to the addition of glass-forming chemicals. Particles in the melter feed for both the LAW and HLW melter preparation and feed systems are assumed to be 40 micrometers in diameter. The slurry melter feed and preparation slurries have a maximum velocity of about 8 feet per second. Erosion is not considered to be significant unless velocities exceed about 10 feet per second. Extrapolating this data in LAW, the erosion rate is estimated at about 1.5 mpy and in HLW, about 2 mpy. In high solids waste streams that do not contain glass formers, as in the PT facility, the erosion rate will be much lower than estimated for the vitrification feed system. However, for added assurance, components believed to have the greatest susceptibility to erosion are being hardened by overlays of Stellite or other suitable hardsurfacing material. Additionally, the use of bent pipe with bends greater than or equal to three times the diameter will be used to reduce the impingement of solid particles and minimize erosion. Based on the references cited, the minimum recommended erosion allowance for lines carrying slurries is 80 mil. BNI has conservatively specified a corrosion/erosion allowance of 0.0937 inch for lines with solids content greater than or equal to 2% by weight. A corrosion/erosion allowance of 0.125 inch is specified for piping where high erosion potential exists due to solid content

[132] Smith, H. D., and M. R. Elmore, *Corrosion Studies of Carbon Steel Under Impinging Jets of Simulated Slurries of Neutralized Current Acid Wastes (NCAW) and Neutralized Cladding Removal Waste (NCRW)*.
[133] Schumacher, R. F., *Glass Formers Characterization*.

or high velocity. In CCN: 047337,[134] BNI stated the WTP project is currently reviewing the assumptions and methodology to verify that these allowances are adequate.

Reviewers found the approach used for erosion/corrosion allowances as specified by BNI in 24590-WTP-3PS-P000-T00001, *Engineering Specification for Piping Material Classes*, and 24590-WTP-P0C-50-00001, *Piping Wall Thickness Calculation*, were consistent with the SRD, Appendix H, "Add Hoc Implementing Standard for Erosion/Corrosion and Assessments." However, subsequent to BNI's response to Question PT-PSAR-215, concerns were raised regarding BNI's conclusion that most of the insoluble sludge is fine-grained and relatively soft. As a condition of acceptance, BNI should assess tank waste characterization data and internal WTP process streams including solids particle size distribution and waste solids hardness. BNI must also re-assess requirements selected for erosion/corrosion based on this assessment. Results of this assessment should be documented in the first revision of the PSAR following authorization for full facility construction.

4. The reviewers found the operating ranges and limits of measured process variables to be acceptable and consistent with those evaluated in the hazard and accident analyses. The reviewers found acceptable the process technology information, including process flow diagrams, process chemistry, and maximum intended inventories. PSAR Section 2.5 and process flow diagrams were reviewed for this evaluation. Also, 24590-PTF-M4C-V11T-00003 was reviewed and found acceptable. (However, see the discussion of Question PT-PSAR-029 in the second paragraph of Section 4.3.2.2, Item 3, of this SER). The reviewers concluded that the PSAR contained adequate information on safe upper and lower limits for parameters controlled for safety reasons (e.g., temperatures, pressures, flows, and compositions) and the consequences of deviations.

5. The reviewers found the information on the PT facility process equipment layout acceptable for the preliminary design of the building. Schematic drawings of the layout in PSAR Volume II, Figures 2A-1 through 2A-17, provided sufficient information to support hazard and accident analysis. BNI provided revised facility process equipment layout information in the response to Question PT-PSAR-256. Changes primarily included the addition of concrete walls to provide additional horizontal shear strength, along with minor resizing and repositioning of process vessels. (See discussion of Question PT-PSAR-256 in Section 4.3.2.2, Item 3, of this SER). Reviewers found the revised information adequate to support the hazard and accident analyses.

6. The reviewers found the description of process related codes and standards to be used with the PT facility acceptable and consistent with SRD Safety Criterion 4.1-2. For the electrical systems and components, the codes and standards identified in PSAR Volume I were found to be acceptable and consistent with SRD Safety Criterion 4.1-2. The reviewers found design codes and standards for the seismic design of PT processes/equipment, as presented in 24590-WTP-DC-ST-01-001, acceptable and consistent with SRD Safety Criteria 4.1-3 and 4.1-4. The reviewers found the codes and

[134] CCN: 047337, letter from R. F. Naventi, to R. J. Schepens, "Response to Defense Nuclear Facilities Safety Board Comments," dated December 17, 2002.

standards identified for designing and constructing the PT mechanical systems, including confinement and air treatment systems, acceptable and consistent with the requirements of SRD Safety Criteria 4.1-1, 4.2-1 through 4.2-4, and 4.4-6 through 4.4-8. In this comparison, consistency with the approved implementing codes and standards for each safety criterion cited above was also verified.

7. The reviewers found the instrumentation and controls for monitoring and safely shutting down the PT processes conditionally acceptable. PT control room habitability was found conditionally acceptable and is discussed in Item 8 of the facility description portions of Sections 4.1.1.2 and 4.2.1.2 in this SER.

   BNI provided information describing instrumentation and control components that were ITS SSCs, consistent with the preliminary facility and process design. Instrumentation and controls required for preventing and mitigating DBEs were identified. Systems and components designated SDC will be designed to Quality Level 1 requirements.

   Where applicable, the PT ITS instrumentation and control design satisfied the single-failure criterion. The design basis described in PSAR Volume II for ITS instrumentation included the applicable implementing instrumentation and control codes and standards identified in SRD Safety Criteria 4.1-2 through 4.1-5, 4.2-1 through 4.2-4, 4.3-1 through 4.3-5, 4.4-2, 4.4-4 through 4.4-8, 4.4-10, and 4.4-21.

8. The reviewers found acceptable the information on the design of the facility process systems for minimizing the production of radioactive and nonradioactive wastes. This information was addressed in 24590-WTP-PL-ENV-01-004; PSAR Volume I, Section 9.3.2; 24590-WTP-PL-ENV-01-006; and in 24590-WTP-PL-RT-02-001. BNI determined the quantities of chemicals added to the process to be necessary to process the various waste streams entering the PT facility and to treat the offgases. The reviewers concluded that waste streams generated during the processing of PT waste streams would be appropriately recycled to minimize the production of new waste volumes.

9. The reviewers found the information relating to process safety information to be conditionally acceptable. This review focused on the requirements of the SRD, Appendix A, Section 4.1, "Identification of Hazards"; and Safety Criteria 3.1-2 and 4.2-3.

   The reviewers found acceptable the information provided on hazardous materials, including toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials. Hazards of the various chemicals used in the PT facility were provided in PSAR Chapter 3, and in reference documents 24590-WTP-RPT-ESH-01-001 and Material Safety Data Sheets. PSAR Tables 3A-4, 3A-5, and 3A-6 summarized the process chemicals used in the PT facility, their characteristics, and their potential interactions.

   BNI identified hazards associated with adding strong nitric acid to ion exchange resins. SRD Safety Criterion 3.1-2 requires a compilation of process safety information, including information pertaining to hazards of material in the process such as inadvertent

mixing of different materials that could occur. Reviewers questioned (Question PT-PSAR-025) whether nitric acid concentrations lower than 3 molar could create uncontrolled chemical reactions with the resin (SuperLig® 644) used in the cesium ion exchange columns, particularly if the temperature were higher than at normal operating temperature. In Question PT-PSAR-025, reviewers also questioned whether prolonged exposure of the resin to radiation and nitric acid that degrades the resin would increase the reaction rate of degraded resin relative to new resin. In response, BNI stated that testing indicates that up to 5 molar nitric acid is unlikely to result in an uncontrolled reaction; however, BNI committed to perform additional laboratory tests to establish a safe upper limit for nitric acid concentration with new and degraded resin. BNI committed to complete the laboratory tests and include the evaluation of the results in the PSAR at the time the testing is complete and the control system and ion-exchange column designs are finalized. The reviewers found this commitment acceptable because the information is expected to be available before the ion-exchange design, including controls, is finalized; and revision and changes to the selected control strategies are unlikely based on current data. Design of ITS SSCs credited to prevent addition of strong nitric acid could be revised, if necessary, before construction of the equipment features is required.

Although required by SRD Safety Criterion 3.1-2, BNI did not include in the PSAR an assessment of the hazards associated with the chemicals contained in the waste feed. Reviewers questioned (Question PT-PSAR-047) this absence. In response, BNI referenced calculation report 24590-PTF-M4C-V11T-00003, which identified the maximum radionuclide concentrations of waste materials at each unit operation in the WTP facilities. The response stated that protection of personnel from these chemical hazards was afforded by the same SSCs that were specified to control radiological hazards of the feed material. The reviewers found this response acceptable.

4.3.1.3 Conclusions

The conclusions for the facility and process descriptions are summarized separately below.

Facility Description – The reviewers concluded that the facility description was conditionally acceptable. In addition, six conditions of acceptance identified in Revision 2 of this SER were completed.

Conditions of Acceptance – BNI must complete the following actions and obtain DOE acceptance of the information provided as conditions of acceptance before DOE authorization of PT subsurface pits, tunnels, and basemat structural concrete placement:

1. Develop a structural design evaluation summary table, as committed to in response to Question PT-PSAR-227. (See Section 4.3.1.2, Item 3[b].) (COMPLETE)

2. From the preliminary SSI analysis results, for each wall and horizontal seismic motion, tabulate (a) the in-plane shear force in the direction of the length of the wall, (b) the maximum in-plane shear stress in the direction of the length of the wall, and (c)

maximum out-of-plane bending moments, one about the horizontal axis and one about the vertical axis. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

3. Compare the out-of-plane bending moments in the subsurface walls from the preliminary SSI analysis for the horizontal seismic motions with those from the GTSTRUDL analysis of the PT building. The applied dynamic soil pressure is based on ASCE 4-98, *Seismic Analysis of Safety-Related Nuclear Structures and Commentary*. These were committed to in responses to Questions PT-PSAR-227. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

4. Modify the design moments and shear forces in calculation report 24590-PTF-DGC-S13T-00002, *Design of Pits, Foundations and Below Grade Walls for PT Building*, using a method similar to that used in the HLW facility design. Include this effect on demand-to-capacity ratios in the structural design evaluation summary. These commitments were provided in the responses to Questions PT-PSAR-227 and -231. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

5. Include both through-thickness thermal loads and thermal growth loads in design calculations and provide justification for not considering all load combinations, as committed to in responses to Questions PT-PSAR-225, -226, and -227. (See Section 4.3.1.2, Item 3[g].) (COMPLETE)

6. Provide a code requirement interpretation for shear wall design limits that would provide a basis for concluding that the shear forces were acceptable using ACI 349-01, as committed to in response to Question PT-PSAR-227. (See Section 4.3.1.2, Item 4.) (COMPLETE)

7. Perform a revised seismic SSI analysis based on the revised building layout in which lateral dynamic soil pressure will be calculated directly for a few critical below-grade walls using soil pressure elements in the SASSI model before authorization for full PT facility construction. If soil pressure is not obtained directly from the revised SSI analyses, the SASSI-generated moment results will be used to estimate the lateral dynamic soil pressure. This was committed to in responses to Questions PT-PSAR-224 and -227. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

BNI must complete the following by the date or milestone indicated:

1. Perform an evaluation of PT internal flooding as part of the common-cause/common-mode failure analysis during ISM Cycle III; identify control strategies for internal flooding events, as necessary, to prevent unacceptable impacts to the safety function of the structure located above the basemat. Before floors are constructed above the basemat, demonstrate, in the flooding assessment, the vulnerability to flooding from internal sources. Where vulnerabilities are detected, provide appropriate mitigation. Provide the results from this analysis to ORP for approval and document them in the first PSAR revision following completion of the hazard analysis. This was committed to in response to Question PT-PSAR-256. (See Section 4.3.1.2, Item 3[f][ii].)

2. Update the SDC UPS description in the PSAR to provide one Plant Protection System division and one respective UPS power division for each redundant SDC division in the PT facility by the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-205. (See Section 4.3.1.2, Item 6.)

Process Description – The reviewers concluded that the process description was conditionally acceptable.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Assess tank waste characterization data and internal WTP process streams including solids particle size distribution and waste solids hardness. Also re-assess requirements selected for erosion/corrosion based on this assessment. Document the results of this assessment in the first revision of the PSAR following authorization for full facility construction. (See Section 4.3.1.2, Item 3.)

2. Perform additional laboratory tests to establish a safe upper limit for nitric acid concentration with new and degraded resin. Complete the laboratory tests and include the evaluation of the results in the PSAR at the time the testing is complete and the control system and ion-exchange column design is finalized, as committed to in response to Question PT-PSAR-025. (See Section 4.3.1.2, Item 9.)

4.3.2 PT Facility Hazard and Accident Analysis

The purpose of this review was to determine whether (1) the PSAR adequately described the hazard and accident analyses performed for the PT facility and (2) the analyses complied with the requirements of the SRD and were consistent with the ISMP commitments. The review also was to determine whether the analyses demonstrated that the PT facility design, construction, operation, maintenance, and deactivation could be performed in a manner that adequately protects the health and safety of the workers, the public, and the environment.

4.3.2.1 Requirements

According to the SRD, Volume II, Appendix A, Section 4.0, "Hazard Evaluation," the following nine elements of hazard and accident analyses are required to be evaluated: (1) identifying hazards, (2) identifying potential accident/event sequences, (3) estimating accident consequences, (4) estimating accident frequencies, (5) considering common-cause and common-mode failures, (6) defining DBEs, (7) defining the operating environment, (8) identifying potential control strategies, and (9) documenting the hazard and accident evaluation. In addition, the identification of assumptions and analysis of uncertainty should be evaluated according to the criteria in RL/REG-99-05, Section 4.3, "Hazard Analysis Methods."

The PSAR should identify and analyze internal DBEs that are affected by the design of the PT facility. For external DBEs, the evaluation should assess selection of the seismic and other external events, including the seismic design criteria.[135] Facility preliminary seismic analyses should be evaluated to ensure that the preliminary PT facility design will meet applicable requirements for load when subjected to the design-basis earthquake. Consistent with the preliminary level of design, the evaluation should assess the chemical process safety of the PT facility design and whether the PSAR adequately identified and analyzed potential chemical hazards and accidents associated with the PT facility.

4.3.2.2 Evaluation

The reviewers evaluated information provided in PSAR Volume II, Chapter 3 and Appendix A, against the applicable criteria defined in the SRD and RL/REG-99-05. Relevant references in the submittals were also reviewed to determine the implementation and documentation of the ISM process as it applied to the PT hazards and accident analysis results. These references included calculations, studies, drawings, system notebooks, and additional detailed information from SIPD, system description reports, and other relevant supporting documentation.

Also, in PSAR Volume II, Appendix B, BNI identified hazardous situations that could potentially affect the design and safety functions of the PT facility. This information was reviewed using the requirements above and applicable RL/REG-99-05 criteria. All nine criteria were conditionally met. The evaluation of the information for each review criterion is summarized below:

1. **Identifying Hazards** – The reviewers found the identification of hazards for the PT facility in the PSAR conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and Appendix A CSD records and the results of the hazard analysis in 24590-PTF-RPT-ESH-02-002, *Design Basis Event Selection for the Pretreatment Facility Preliminary Safety Analysis Report*. The reviewers evaluated the results of the identification of hazards associated with the processes, design, and operations that could affect the PT facility and their potential consequences, possible causes, and estimated initiating frequencies. PSAR Appendix A identified hazards for the full PT facility that were above SL-4 (as defined in the SRD Appendix A, Section 4.3.1) and chemical consequences above threshold. BNI provided a complete hazard identification, including SL-4 hazards, in 24590-PTF-RPT-ESH-02-002. PSAR Section 3.3.2 documented the hazards identification results, including identification of the hazardous chemicals and a discussion of possible chemical interactions. The hazard evaluation results were provided in PSAR Section 3.3.3 and in Appendix A. All 923 SIPD CSD entries in PSAR Appendix A were reviewed in the PT facility hazards identification process; of these, 506 events had SL-1, -2, or above threshold consequences to the facility worker, and 211 events had SL-1, -2, or above threshold consequences to the co-located worker or the public. Results were included for waste receipt, evaporation, ultrafiltration, blending and storage systems, cesium and technetium ion exchange process systems, mechanical

[135] RL/REG-99-05, Section 4.6, "External DBEs."

handling systems, process vessel vent and pulse jet ventilation systems, reagent systems, and HVAC systems.

The PT facility was preliminarily categorized as Hazard Category 2 using DOE-STD-1027-92. The reviewers evaluated the basis for this preliminary categorization (24590-PTF-Z0C-U10T-00001, *Hazards Categorization for Pretreatment*) and found it to be acceptable.

DOE/RL-96-0003, Section 4.3.2, Items A.9 and A.11, state, in part, that the PSAR shall contain a description of facility features and functions provided to control the radiological, nuclear, and process hazards; and an analysis of hazards-control features during all expected facility operating modes, off-normal conditions, and design basis internal and external events. Reviewers questioned (Questions PT-PSAR-269 and -276) the impacts of water hammer and steam line break loads to structures and ITS SSCs located in the PT facility. In response, BNI stated that the systems primarily susceptible to water hammer are steam and hot water systems and that the PSAR did not address the hazards associated with water hammer or steam line breaks because of the limited design detail available for such analyses. In responses to Questions PT-PSAR-269 and -276, BNI committed to identify and examine these hazards during the ISM Cycle III hazard topography process. In response to Question PT-PSAR-276, BNI further stated that all ITS SSCs have the potential to be impacted by a steam line break in the PT facility. BNI also stated that the loads associated with water hammer would be considered in designing piping supports according to project design guide 24590-WTP-GPG-ENG-005, *Engineering Design Guide for Pipe Support*. This guide requires a pipeline list to be prepared, documenting details on pressures and temperatures, insulation requirements, and materials of construction. Reviewers found acceptable the commitment to perform the hazards analysis for water hammer during the ISM Cycle III hazard topography process and document the results in the following annual PSAR revision because the location of ITS SSCs will not be definitively determined until that time, and the water hammer loads on the PT facility concrete structures will be bounded by other dynamic structural forces and loads, such as seismic.

SRD Safety Criterion 4.1-1 requires the facility design to provide for the prevention and mitigation of risks associated with radiological and chemical material inventories and energy sources. Three concerns were raised regarding the application of this criterion during the review. The reviewers identified that a potential hazardous condition existed in the PT facility because of the accumulation of flammable concentrations of ammonia. Specifically, the reviewers questioned (Question PT-PSAR-199) whether ammonia contained within the waste streams entering the facility could be released from the liquid phase into the gaseous phase by processes that could change the solubility of the ammonia, such as addition of concentrated sodium hydroxide. Reviewers postulated that if sufficient quantities were present and released at a sufficient rate, the ammonia concentration could exceed the lower flammability limit of 15% and ignite. In response, BNI committed to analyze this hazardous situation and document the results in the first PSAR revision following authorization for full facility construction. Notwithstanding the incomplete PSAR hazard analysis, the reviewers found this commitment acceptable because the control strategies for all deflagration events, including ammonia

deflagrations, will be based on prevention consistent with controls used for hydrogen dilution, will not impact the design of the PT structures, and will be incorporated in the PSAR well before construction of these features is required.

Reviewers questioned (Question PT-PSAR-290) whether explosive or combustible levels of ammonium nitrate could form and accumulate in the process vessel ventilation system because both ammonia and nitrogen oxide vapors will be present in the system. In response, BNI performed calculations to determine whether ammonium nitrate could be formed and concluded that it is thermodynamically possible, but the chemical kinetics of the reactions are unfavorable. However, accumulation of ammonium nitrate has been observed in West Valley and Savannah River facilities. Inspection and flushing are periodically performed there to remove these deposits. In the next revision of the PSAR, BNI committed to develop and include a basis for the frequency and locations of periodic flushing (if needed) of the vent lines to prevent ammonium nitrate buildup and to determine the need for inspection ports. Reviewers found this commitment acceptable because provision for inspection and flushing, if needed, can be specified before construction of the ventilation systems.

PSAR Volume III, Section 3.4.2.2, identified a number of streams in the PT facility that comprise the LAW feed that would be sampled as part of the strategy to prevent transfer of HLW to the LAW facility. Similarly, PSAR Volume IV contained a commitment that the HLW facility feed will be sampled at the PT facility before the HLW feed is transferred to the HLW facility. PSAR Volume II discussions pertaining to sampling were inconsistent with the information in PSAR Volumes III and IV and did not include all specific requirements for sampling. As a result, reviewers questioned (Question PT-PSAR-333) the sampling activities in the PT facility. In response, BNI committed to revise the PSAR in the next revision following authorization for full facility construction to eliminate these inconsistencies and to incorporate administrative controls described in the LAW and HLW sections of the PSAR for sampling required to protect the LAW and HLW facilities. Reviewers found this commitment acceptable.

2. **Identifying Potential Accident/Event Sequences -** The reviewers found conditionally acceptable the identification of potential accident/event sequences for the PT facility, as described in PSAR Chapter 3 and Appendix A CSD records and in 24590-PTF-RPT-ESH-02-002. PSAR Sections 3.3.1, 3.3.2, and 3.3.3 described the identification of internal and external events. The reviewers evaluated this information against acceptance criteria in RL/REG-99-05, Section 4.4.3.3, Item 2. The information satisfied the requirements in SRD Safety Criterion 3.2-1; the SRD, Appendix A, Section 4.2, "Identification of Potential Accident/Event Sequences"; and the ISMP, Section 1.3.6, "Accident Analysis," except as discussed below.

The CSD records for the full PT facility contained information on the potential consequences, a summary of their hazardous situations or sequences, estimated initiating frequencies, control strategy elements, and safety case requirements of administrative controls or engineered features for each hazard. PSAR Section 3.3.3 summarized potential hazardous situations or accident sequences for the SSCs by their location. The rationale was described for sorting internal hazardous situations (internal events) into

accident groups or categories and for selecting specific cases to be analyzed in more detail, and the basis was described for selecting the accident sequences. In Section 3.4.2, the external events were described. Both internal and external event sequences are discussed below.

(b) **Internal Events** – The reviewers found the description of internal events conditionally acceptable. PSAR Chapter 3 and Appendix A, when supplemented by the referenced calculation reports (see Section 8.0 of this SER), acceptably provided (i) accident sequences that identified initiating events with their prevention and mitigation measures and other contributing phenomena, (ii) the rationale for sorting hazardous situations into accident groups or categories, and (iii) selection of accident sequences. The PSAR identified 10 types of internal DBEs for the PT facility: (1) vessel overflows, (2) spray leaks, (3) pressurized releases, (4) liquid spills, (5) boiling, (6) explosions, (7) fire, (8) drop of radioactive material, (9) loss of contamination control, and (10) direct radiation.

The reviewers questioned (Question PT-PSAR-025) why BNI concluded that sodium permanganate, which is used in the ultrafiltration feed preparation step to promote separation of transuranic radionuclides, could not be credibly introduced into the cesium ion exchange columns. In response, BNI stated that the introduction of permanganate into the columns was precluded by design features inherent to the process. Limited permanganate quantity and dilution in multiple vessel heel volumes precluded reactive concentrations of permanganate from reaching the ion-exchange columns in the possible misroute paths to the columns. BNI committed to further verification that the design features are inherent using Revision 0 design media; and if necessary, an ITS permanganate concentration monitor will be included in the design, or a TSR will be prepared to preserve minimum heel volumes in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable because the control strategies selected can be readily implemented once they are finalized.

(c) **External Events** – The reviewers found the description of external events conditionally acceptable. The reviewers evaluated PSAR Section 3.4.2 for the impacts of external events, where such impacts would directly affect the PT facility or would impose design requirements (e.g., seismic) on the PT facility. The analysis of the seismic DBE assumed that all SC-I and -II SSCs continue to function and all SC-III and -IV SSCs fail. Reviewers found this assumption acceptable. The scenario was comprised of multiple events or failures, including process vessel failures, contaminated equipment drops, and crush/impact events involving HEPA filters and mist eliminators.

The PSAR also considered other external natural or man-made events, such as flooding, wind, ash and snow fall, and aircraft crashes, for their impact on the PT facility design. The PT structure is designated PC-3 and is designed to prevent damage from external events such as flooding, wind, and ash and snow fall. No structural requirements were necessary to protect the facility from aircraft crashes.

Reviewers found treatment of these events acceptable except as discussed below for ashfall and transportation events.

Reviewers questioned (Questions PT-PSAR-204 and -257) how potential impacts from secondary events directly caused by external events, such as significant ash and smoke generation from volcanic eruptions or range fires and hazardous chemical releases from transportation accidents, had been addressed, in accordance with SRD Safety Criteria 3.1-4 and 4.1-3. In response, BNI stated that potential effects of external events such as transportation accidents are analyzed for the WTP facilities (LAW, HLW, PT, BOF, and Lab) and are documented in Chapter 1 of PSAR Volume I. BNI also committed to re-evaluate the design basis ashfall event and transportation events to address impacts from secondary events. These commitments are described in detail in this SER: Section 4.3.3.2, Item 5, for a design basis ashfall event and Section 4.2.2.2, Item 6(c)(vi), for transportation events. BNI committed to include initial results of the evaluation of these events in the first PSAR revision following authorization for full facility construction and to include final results in the FSAR. Reviewers found the commitments acceptable for the design basis ashfall event because reasonable provisions will be provided to rapidly replace loaded filters and wash filters or provide other means to ensure that ventilation systems can maintain confinement and backup air supplies remain operable as described in Section 4.3.3.2 of this SER. Reviewers also found the commitment acceptable for the transportation event because the existing analysis of transportation events (done by BNFL for the WTP) remained acceptable for construction authorization pending this revision, as described in Section 4.2.2.2 of this SER. These commitments are appropriate for the preliminary design detail submitted with the PSAR.

3. **Estimating Accident Consequences** – The reviewers found the estimation of accident consequences to be conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and Appendix A CSD records and the results of the unmitigated consequence analysis in calculation report 24590-PTF-Z0C-W14T-00002, *Revised Severity Level Calculation for the Pretreatment Facility.* The reviewers evaluated the description of the results of the calculated unmitigated and mitigated consequence analysis for the potential accident/event sequences associated with the process, design, and operational hazards that could affect the PT facility.

PSAR Section 3.3.2.1.1 stated that ^{137}Cs, ^{90}Sr, and ^{241}Am are important to the inhalation dose calculation under accident conditions for most areas of the WTP. Calculation report 24590-PTF-M4C-V11T-00003 stated that a lower ^{241}Am feed concentration than the Contract limit for Envelope D solids is assumed and that ^{241}Am in the feed is assumed to be reduced (from the Contract maximum) by a factor of 2.4. Reviewers questioned (Question PT-PSAR-029) the use of less-than-Contract-maximum concentrations of ^{241}Am in severity level (unmitigated consequence) and DBE (mitigated consequence) calculations. In response, BNI stated that the feed concentration for ^{241}Am would be raised to the Contract maximum in a recalculation. BNI also stated the recalculation using contract maximum will not affect the DBE selection report or the selection of

control strategies because recalculated mitigated consequences will increase by a factor of two and will remain well below the radiological exposure standards. In the response, BNI stated changes to the severity level calculations and DBE calculations will be required and the revised calculations will be reflected in the next revision of the PSAR. Severity levels in the revised calculations for the selected DBEs are not expected to change. Reviewers found this commitment acceptable for PT facility design and construction because neither new DBEs nor new control strategies were likely due to the factor-of-two increase in all unmitigated and mitigated consequences.

During the OSR review of the PSAR, BNI made two significant design changes: (1) reconfiguration of shear walls to address seismic forces and (2) reconfiguration and resizing of HLW lag storage and feed blending process (HLP) system vessels. BNI documented these design changes and their impact to facility hazards, the DBE consequences, and the control strategies in the response to Question PT-PSAR-256. The ISM process was used to identify and evaluate the hazards affected by the HLP system design change, resulting in 19 new CSD records, primarily in the liquid spill, overflow, pressurized release, and vessel boiling accident types. However, no new initiating events or safety case requirements were identified; therefore, none of the new CSD records replaced a hazardous situation analyzed as a DBE in the PSAR. BNI committed to incorporate these facility design changes in the DBE calculations, seismic probabilistic risk analysis, operations risk assessment, and the PSAR in the first PSAR revision following authorization for full facility construction. Reviewers found this commitment acceptable because the impacts on the hazards and accidents described in the PSAR were reviewed using the ISM process and have been demonstrated to be either bounded by the DBE analysis in the PSAR or the increased mitigated consequences (2E-05 vs. 5E-06 rem to the public, 3E-05 vs. 1E-05 rem to the co-located worker for the liquid spill DBE) remained well within the radiological exposure standards. The unmitigated consequence increase for the liquid spill did not change the severity levels, which were already SL-1 to the public, co-located worker, and the facility worker.

The following describes in more detail the evaluation of unmitigated and mitigated accident consequences:

(a) **Unmitigated Consequences** – Calculation report 24590-PTF-Z0C-W14T-00002 on unmitigated consequence severity level evaluated radioactive material drops, liquid spills, vessel overflow, spray leak events, pressurized releases, vessel boiling, cesium ion exchange column events, hydrogen explosions, fire, loss of contamination control, and direct radiation hazards. The reviewers evaluated the specific scenarios that were analyzed for the PT facility and that affected the PT facility design, the assumptions used, and the results of the unmitigated consequence calculations. The reviewers determined that the severity level assignments for the postulated accident sequences were acceptable, except for hydrogen deflagrations, according to the SRD, Appendix A, Section 4.3.1, "Accident Severity Level Identification." This conclusion was reached because (1) consequences accounted for type, form, and quantity of radioactive material and the energy sources available to interact with the hazardous material; (2) no

credit was taken for mitigative or preventive controls; and (3) the consequences were evaluated for ground level releases.

Estimation of the unmitigated consequences from a hydrogen deflagration was not acceptable to the reviewers and did not meet the requirements of SRD Safety Criteria 4.1-1, 4.2-1, and 4.4-8. For hydrogen deflagration, the reviewers questioned (Questions PT-PSAR-023, -024, -028, -289, -293, -294 and -336) the adequacy of the models and assumptions used in identifying and analyzing hydrogen deflagrations for severity level determinations. For example, the reviewers asked whether the conditions and parameter values used for the severity level calculations were bounding according to SRD Safety Criterion 4.1-1. Reviewers noted that the quantity of hydrogen involved in the explosion in a feed receipt tank was not bounding, nor was an explosion in multiple tanks by propagation through a common ventilation system considered in the PSAR. Also, the consequences of detonations in a feed receipt tank, in the cesium IX column, and in the tank farms-to-PT-facility transfer line were not conservatively determined. Finally, the hydrogen generation rates were not conservatively determined. BNI committed to revise hydrogen generation rates and severity level analyses in the appropriate DBE calculations and in the first revision of the PSAR following authorization for full facility construction to address the following:

- The reviewers found that the PSAR did not use suitable empirical equations to calculate the hydrogen generation rates. Reviewers asked (Question PT-PSAR-023) how accident conditions were postulated according to SRD Safety Criterion 4.1-1 when a nonconservative hydrogen generation rate was assumed for treating low nitrate/nitrite concentrations. In response, BNI committed to revise the calculations in 24590-PTF-Z0C-W14T-00002 to more conservatively account for the concentrations of the nitrate/nitrite ions by using Equation 2-3 rather Equation 2-2 from RPT-W375-SA00002.

- Reviewers also questioned (Question PT-PSAR-336) why BNI did not use the maximum temperatures expected under abnormal or accident conditions, such as extended loss of cooling, to calculate hydrogen generation rates using the thermolysis equation (Equation 2-5) given in 24590-PTF-Z0C-W14T-00002. In response, BNI committed to perform all hydrogen generation rate calculations for tanks that could self-boil within 300 hours using a maximum temperature of 220°F, corresponding to the approximate boiling temperatures of the wastes, and using an increased activation energy (100 vs. 91 kJ/mole).

- In response to Questions PT-PSAR-024 and -028 regarding the use of the TNT model and nonconservative hydrogen quantity and concentration assumptions, BNI committed to designate all hydrogen deflagration events to be SL-1 for all receptors.

- In response to Question PT-PSAR-289 on hazards to workers who must perform maintenance on process air and water lines connected to the vessels, BNI committed to evaluate the potential for piping systems and ancillary equipment to accumulate hydrogen as well as potential control strategies.

- In response to Question PT-PSAR-293 on the potential hydrogen levels in gases exiting the evaporator condensers, BNI stated that hydrogen concentrations could range from 6.4 vol% to 25 vol% in the feed evaporation process system. BNI committed to finalize calculations to verify that the instrument air supply rate and noncondensed steam conditions are sufficient to keep the evaporators below 25% of the lower flammability limit in the offgas systems.

In response to Question PT-PSAR-294 regarding the accumulation of hydrogen in vessels containing low liquid levels when pulse jet mixers are automatically stopped, BNI committed to develop administrative controls in ISM Cycle III to prevent hydrogen buildup and document the results in the FSAR.

The responses to these hydrogen-related questions and commitments were acceptable to the reviewers because the control strategies selected for these events are to prevent hydrogen or other deflagrations. These control strategies would not be changed even if the unmitigated consequences increased (as they are likely to do) because the severity level calculated for a deflagration in a waste receipt tank was already determined to be SL-1 for the three receptors, and deflagrations in the cesium ion-exchange column and in the transfer line were already SL-1 to the facility worker and co-located worker. Moreover, the preventive controls are already redundant and meet the single-failure criterion.

SRD Safety Criterion 4.1-2 requires, in part, that items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Reviewers found errors in several DBE calculations; as one example, reviewers questioned (Question PT-PSAR-259) why equations used in 24590-PTF-Z0C-W14T-00022, *DBE Analysis of Spray Leak Events for the Pretreatment Facility*, and shown in PSAR Section 3.4.1.4, were not consistent with the methods used in calculation references for fluid flow through an orifice. Reviewers also found additional errors, as discussed in Questions PT-PSAR-023, -042, -199, and -258. BNI committed to correct these errors by the first PSAR revision following authorization for full facility construction. Reviewers found this commitment acceptable because the errors did not impact the calculated severity levels or selected control strategies or because commitments were made to revise selected control strategies, as was the case for Question PT-PSAR-042, which asked where selected portions of the plant cooling water system will be pressurized (see Section 4.3.3.2, Item 8, of this SER).

Recognizing that the occurrences of calculation errors were quite extensive and involved every calculation used to support the PSAR, BNI conducted an internal

assessment May-June 2002 of 27 WTP calculations, including 5 of the 16 severity level and DBE calculations for the PT building. The assessment was documented as 24590-WTP-MAR-ESH-02-009, *Management Assessment of Safety Analysis Calculations*, and concluded that while the problem was pervasive, "there were no impacts to the conclusions reached in the calculations and that no changes would result in the safety control strategies specified." With the exception of the error identified in Question PT-PSAR-042, discussed above, this conclusion is consistent with that reached by reviewers, as documented in the above paragraph. As a result of the assessment, 24590-WTP-CAR-QA-02-095, *Corrective Action Report*, was generated and included in 24590-WTP-MAR-ESH-02-009. One of the recommendations of the assessment was that all severity level and DBE calculations for PT be reviewed using the same assessment process used in 24590-WTP-MAR-ESH-02-009, based on the finding that all reviewed calculations contained errors of varying significance. Reviewers agreed with the findings and the recommended corrective actions of the management assessment.

(b) **Mitigated Consequences** – The PSAR contained mitigated accident evaluations of radioactive material drops, liquid spills, vessel overflow, spray leak events, pressurized releases, vessel boiling, cesium ion exchange column events, hydrogen explosions, fire, loss of contamination control, and direct radiation hazards. The description of the events included the initial control strategy, source term, frequency and consequence estimates, comparisons of estimated mitigated consequences to the radiological exposure standards of SRD Safety Criterion 2.0-1, discussion of final control strategy (credited mitigative and preventive features), and defense-in-depth considerations. In addition to the analyses in the PSAR, the reviewers evaluated the following supporting calculations reports:

- 24590-PTF-Z0C-W14T-00020, *Design Basis Event: Pretreatment Drop of Radioactive Materials*
- 24590-PTF-Z0C-W14T-00024, *DBE Analysis of Liquid Spill Events from Process Lines and Vessels in the Pretreatment Facility*
- 24590-PTF-Z0C-H01T-00025, *Design Basis Event – Pretreatment Plant Overflow Vessel Overflow Calculations*
- 24590-PTF-Z0C-10-00002, *Design Basis Event – Pressurized Release*
- 24590-PTF-Z0C-W14T-00022, *DBE Analysis of Spray Leak Events for the Pretreatment Facility*
- 24590-PTF-Z0C-S11T-00001, *Design Basis Event: Pretreatment Facility Seismic*
- 24590-PTF-Z0C-H10T-00002, *Design Basis Event – Vessel Boiling Calculations*

- 24590-PTF-Z0C-W14T-00026, *Design Basis Event – Hydrogen Accumulation in Cesium Ion Exchange Column Gas Separation Vessel*
- 24590-PTF-Z0C-W14T-00027, *Design Basis Event – Overheating of Cesium Ion Exchange Media*
- 24590-PTF-Z0C-W14T-00030, *Design Basis Event: Runaway Nitric Acid/Resin Reaction in Cesium Ion Exchange Column*
- 24590-PTF-Z0C-W14T-00023, *Design Basis Event: Fires in the Pretreatment Facility*
- 24590-PTF-Z0C-10-00005, *Design Basis Event – Pretreatment Loss of Contamination Control*
- 24590-PTF-Z0C-10-00003, *Design Basis Event: Direct Radiation Hazards in the Pretreatment Facility*
- 24590-PTF-DBC-S15T-00001, *Structural Drop Load Analysis for PT Building*.

The reviewers concluded that appropriate methodology, data, and assumptions were used in the accident analyses. The analysis results, consisting of final control strategy selection, mitigated consequences with the credited mitigative and preventive controls, and compliance with SRD Appendix A criteria for meeting the radiation exposure standards of SRD Safety Criterion 2.0-1 with significant margin, were conditionally acceptable.

The reviewers questioned (Question PT-PSAR-025) why the caustic/water addition system rather than the emergency elution system was selected as the control strategy to prevent cesium ion exchange heating following a seismic event. Eluting the loaded cesium ion exchange resin would eliminate the hazard associated with heating while caustic/water addition only cools the resin. In response, BNI stated that the caustic/water addition system, which will be available to add caustic or water to the columns, is ITS and SC-I and could be used to prevent the column from overheating and drying out. BNI stated that the ability to elute the resin would be lost following a seismic event because the emergency elution system is not ITS or qualified to withstand a seismic DBE. However, BNI also stated that an ITS SC-I, gravity-fed elution source would be considered for the seismic event in order to remove the cesium from the column and prevent prolonged exposure of the resin to radiation degradation. Extended exposure could lead to a runaway chemical reaction when the cesium is ultimately eluted with dilute nitric acid to remove it from the degraded resin. Also, as noted in this SER, Section 4.3.1.2, "Process Description," Item 9, BNI committed to perform additional laboratory tests to determine whether prolonged exposure of the resin to radiation would increase the reaction rate of degraded resin with low concentrations of nitric acid. BNI committed to reconsider the need for this

elution source in the first revision of the PSAR following authorization for full facility construction. The reviewers found this commitment acceptable because the credited control for preventing a cesium ion exchange column leak and dryout in a seismic DBE is the ITS SC-I design of the ion exchange vessel and caustic/water addition system.

4. **Estimating Accident Frequencies** – The reviewers found the estimation of accident frequencies conditionally acceptable. The reviewers evaluated PSAR Chapter 3 and Appendix A CSD records and the results of the hazard analysis in 24590-PTF-RPT-ESH-02-002. The reviewers evaluated results of the frequency determinations that were based on the methodology described in 24590-WTP-GPP-SANA-002C for the potential accident/event sequences associated with the hazards from the processes, design, and operations that could affect the PT facility.

   Reviewers questioned accident frequencies in a number of questions (Questions PT-PSAR-051, -052, -055, -125, -127, and -211). In response, BNI stated references to target frequencies would be deleted in the first revision of the PSAR following authorization for full facility construction. Reviewers found this commitment acceptable because, subsequent to submittal of the PSAR, ABCN 24590-WTP-ABCN-ESH-02-019, *Deletion of Requirement to Use Target Frequency and Revision to SC 4.1-3 and 4.1-4*, Revision 0, was approved revising the approach to frequency determination. In the review of 24590-WTP-ABCN-ESH-02-019, ORP concluded that, as used in the SRD, the definition of target frequencies established in the SRD and PSAR is not necessary in the selection of control strategies. The dose standards, risk goals, and top-level standards (including defense-in-depth principles), not the target frequencies, establish the control strategies selected for implementation of defense-in-depth requirements. Whereas the target frequency concept may be useful for ensuring that preventive controls are considered over mitigation controls, this consideration is also ensured by the defense-in-depth principles outlined in the SRD; therefore, the target frequency concept can be deleted.

   - **Frequency of Initiating Events** – Reviewers found the description of initiating event frequency to be acceptable except as noted below. While the facility is unique, the DBE initiating events of concern (e.g., leaks, spills, and equipment drops) are common industrial events for which historical information concerning frequency of occurrence is available. A component reliability database of available industry data was compiled from a number of sources, including AIChE's Center of Chemical Process Safety, the Westinghouse Savannah River Company, EG&G Idaho, Inc., the International Atomic Energy Agency, and the Institute of Electrical and Electronics Engineers. This database was used for estimating initiating event frequencies.

     PSAR Volume II, Appendix A, included CSD records for identified hazards, including their initiating event frequencies that had the potential to produce radiological consequences above SL-4 and chemical consequences above threshold with two exceptions: (1) ammonia releases from process wastes followed by a deflagration and (2) ammonium nitrate formation, deposition, and explosion. These two items are discussed in Item 1 above.

- **Frequency of Mitigated Accidents** – The reviewers found the description of mitigated accident frequency to be acceptable except as noted below. For the DBEs analyzed in the PSAR other than hydrogen deflagration and direct radiation, the selected final control strategies were mitigative rather than preventive. Therefore, the mitigated frequency of the accidents was the same as the initiating event or unmitigated accident frequency and was acceptable for the reasons stated in the bullet above.

  The PSAR contained analyses of hydrogen deflagration and direct radiation DBEs that were prevented. The PSAR stated that the mitigated frequency of these DBEs was reduced to $<10^{-6}$/yr (beyond extremely unlikely) by the credited control strategies. Reviewers found the treatment of mitigated frequency for direct radiation DBEs acceptable. Reviewer concerns and the accepted resolution regarding the analysis of hydrogen generation, which impacts the frequency of the hydrogen deflagration initiating event as well as the mitigated frequency, are described in Item 3(a) above. BNI's responses to the hydrogen-related questions and commitments were acceptable to the reviewers because the control strategies selected for these events would prevent hydrogen deflagrations (i.e., reduce the mitigated frequency to well below 10^{-6} per year).

5. **Considering Common-Cause and Common-Mode Failures** – The reviewers found the selection of common-cause and common-mode failures conditionally acceptable. This selection was described in PSAR Section 3.5 and the results of the hazard analysis in 24590-PTF-RPT-ESH-02-002. The description of credible common-cause events that could affect the safety functions of the PT facility was reviewed and included natural phenomena events, external manmade events, loss of electrical power, fire, internal missiles, and internal flooding.

   The SRD, Appendix A, Section 4.5, "Consideration of Common Cause/Common Mode Failures," states, in part, "The following are typical common cause events: ... Internal flooding. Common cause events should be treated as discrete events in the hazard analysis. The analyses of common cause events shall focus on identifying provisions to prevent the loss of safety function." Reviewers questioned (Question PT-PSAR-256) what provisions would ensure that ITS equipment will continue to function during a flooding event. BNI committed to evaluate the flooding hazard for ITS equipment (both electrical and mechanical) as part of the hazard topography evaluations scheduled during ISM Cycle III. These evaluations will be conducted consistent with the facility construction schedule, which requires the design to be developed for a sequence of plant areas. Results will be documented in the PSAR in annual updates. Reviewers found this commitment acceptable because information required for the analysis will not be available until the detailed design is performed and likely controls such as spray shields and berms can be added before electrical and mechanical equipment is installed.

   PSAR Section 3.5 considered three broad categories of dependencies to classify and define the common-cause failures that were expected to be important: functional, spatial, and institutional. Each represented a functionally different way in which commonalities

between redundant systems, trains, or components could potentially reduce the overall expected reliability.

Functional dependencies reflect the reliance of multiple systems, trains, or components on a single system, train, component, or process condition. These dependencies were evaluated in the PSAR to ensure that the reliance of ITS SSCs on other active support systems such as electrical power and air and water systems was recognized, and failure modes of these support systems were evaluated to ensure that the ITS SSCs could perform their associated safety functions in the event of support system failure. Reviewers found the evaluation of dependency on support systems acceptable and consistent with requirements in the SRD, Appendix A, Section 4.5.

Spatial dependencies determine the impact of failure of two components as a result of their co-location in an area that experiences the effects of (a) internal fires or explosions; (b) internal floods from failed tanks, cooling systems, etc.; (c) externally applied forces and loads from seismic activity, airplane crashes, vehicle crashes, etc.; and (d) natural forces and environmental hazards, such as severe weather, lightning, floods, and external fires. Defense against spatial dependencies comes from hardening or protecting each component to make it less vulnerable to the specific hazard of concern and from physically separating them to minimize the likelihood of multiple failures from a single casualty. Spatial dependency-related internal events, including flooding (see above), fires, and two-over-one (non-ITS items failing in such a manner as to impact the safety function of SC-I SSCs), are expected to be considered in ISM Cycle III and during detailed design when required design detail is available.

PSAR Appendix A evaluated the impacts of external events on the PT facility and concluded that the PT facility structure would be classified as SC-I for seismic events and PC-3 for externally applied natural forces (e.g., wind and external flood) to prevent the occurrence of multiple identified SL-1 events (due to spatial dependencies) as a result of the seismic DBE or other NPH as a common-cause event. The reviewers agreed with this conclusion.

Other NPHs discussed above, i.e., lightning and external fire, have been evaluated in PSAR Volume I (submitted to support the PCAR) and in the PT PFHA. PSAR Volume I stated that "… fires are mitigated by administrative action including keeping the area surrounding the WTP free from dry vegetation and other flammable material." Reviewers found this administrative action and the lightning protection system adequate to mitigate these external hazards.

The PSAR addressed institutional dependencies arising from in-plant activities (by maintainers, operators, designers, and equipment procurers) that result in the near-simultaneous failure of otherwise independent components. The effect of institutional dependencies is often manifest as a set of components failing in the same way at approximately the same time. Some of the causes of institutional dependencies are use of identical components with the same maintenance and operating cycle; failure of multiple components resulting from inherent design weaknesses or from the misapplication of hardware; labeling, training, and procedural and administrative control

inadequacies that allow or cause operators/maintainers to make the same or similar errors on more than one system, train, or component; or use of a single maintenance crew to maintain/adjust/calibrate independent equipment during the same time period (a mistake/error while maintaining or restoring one piece of equipment is repeated on a second, similar piece of equipment, increasing the probability of near-simultaneous failure). Defense against dependencies arising from the above causes involves activities defined during detailed design, procurement, installation, and operation (including maintenance), rather than in the PSAR; provisions for avoiding institutional dependencies need to be made in the FSAR and TSRs. Reviewers found the approach for defense against failures due to institutional dependencies acceptable for the PSAR.

6. **Defining DBEs** – The reviewers found the set of DBEs identified for the PT facility to be conditionally acceptable. The selection of internal DBEs for PT was described in 24590-PTF-ESH-02-002, *Design Basis Event Selection for PTF PSAR.* Internal, seismic, and other external DBEs are discussed below:

   (a) **Internal DBEs -** The reviewers found the definition of internal DBEs in the PSAR to be conditionally acceptable. For these DBEs (e.g., radioactive material drops, liquid spills, vessel overflow, spray leak events, pressurized releases, vessel boiling, cesium ion exchange column events, hydrogen deflagrations, fires in the PT facility, loss of contamination control, and direct radiation hazards), the PSAR adequately summarized the DBEs identified in the hazard analysis. The reviewers found that PSAR Chapter 3 and Appendix A, along with the calculations listed in Item 3(b) above, provided (i) comprehensive and credible accident sequences that identified initiating events with their prevention and mitigation measures, and other contributing phenomena and (ii) the rationale for sorting hazardous situations into accident groups or categories.

   Reviewers questioned (Question PT-PSAR-198) why BNI did not select events that could result in a vessel boiling much faster than assumed in the boiling DBE. Specifically, failure of the temperature control system or a steam supply valve while caustic leaching at elevated temperature in the ultrafiltration feed tanks could result in boiling much more quickly than the loss of cooling and self-heating scenario described in the PSAR. The much larger heat source could also create a larger release of radioactive aerosols due to the more vigorous boiling that would be encountered. In response, BNI stated that the capability for steam heating these tanks was included in the PSAR to indicate future processing capability as required in the BNI Contract and was not included in the authorization basis being requested from DOE. BNI stated that the need for hot caustic leaching would be re-evaluated; however, these two accidents will be addressed in the DBE boiling calculations in the first revision of the PSAR following authorization for full facility construction. The reviewers found this commitment acceptable because controls are expected to be the same as for boiling (i.e., PT vessel vent process/process vessel vent extraction system and C5 ventilation system in addition to the vessel and cell boundary).

DOE/RL-96-0003, Section 4.3.2A, Items 8 and 11, require the PSAR to contain analysis of radiological, nuclear, and process hazards for the design and analysis of hazards control features during all expected facility operating modes, off-normal conditions, and design basis internal and external events. Appendix A of the PSAR identifies "tank bump" hazards as potential high consequence events. DBE calculation report 24590-PTF-Z0C-10-00002 stated that these events are represented and bounded by "steam operated emptying ejector" accidents. The reviewers questioned (Question PT-PSAR-098) how the "tank bump" accidents were represented by this accident. "Tank bumps" are caused by a different physical phenomenon than the other hazards in this category and could potentially result in aerosolization of superheated waste solids directly into the tank headspace on very short timescales. The tank bump potential aerosolization mechanism is not related to entrainment from bubbly flow resulting from boiling or steam jet entrainment. The WTP process presents a unique exposure to the hazard of "tank bumps" because of high solids content waste, which may be present in several WTP processing tanks. The initial conditions for a tank bump can occur if a large quantity of waste solids settles in a thick layer at the bottom of a processing tank and is allowed to heat up to the saturation point. In the response to Question PT-PSAR-098, BNI committed to develop a separate tank bump DBE analysis and document the results in the first revision of the PSAR following authorization for full facility construction. Reviewers found this commitment acceptable because the expected control strategy required for tank bump prevention is mixing, and this control has already been selected to prevent episodic hydrogen release. Moreover, the amount of mixing to prevent episodic hydrogen release should be sufficient to prevent a tank bump. Reviewers concluded that adequate mixing to prevent solids settling will be effective in preventing a tank bump because it prevents the required initial condition with settled solids.

Reviewers questioned (Questions PT-PSAR-055 and -129) the basis for selecting as a DBE a postulated leak in the transfer line between the tank farms and the PT facility because transfers between the PT and HLW facility would have a higher source term. In response, BNI summarized a new DBE analysis and committed to include it in the first PSAR revision following authorization for full facility construction. The new analysis postulated a leak in the transfer line between the PT facility and the tank farms as a result of an excavation accident. The leak is postulated to occur in transfer piping buried between 5 and 16 feet deep. Once the breach occurs, the overburden would collapse back into the hole, covering the leaking pipe. To analyze the consequences of the mitigated accident, BNI conservatively assumed that the leak occurred in the section of transfer pipe between the tank farms and the PT facility because this is the longest span of transfer pipe and that the source term corresponded to a transfer between the PT and HLW facility. The resulting consequences were a dose of 10 rem to the facility worker, who was assumed to be exposed to the pool of leaked waste for 30 minutes; $6x10^{-5}$ rem for the co-located worker; and $8.15x10^{-9}$ rem for the public, who was assumed to be exposed for an hour. Reviewers found the re-analysis and commitment to revise the PSAR acceptable.

(b) **Seismic DBEs** – The reviewers found the external DBE definition for the PT facility to be conditionally acceptable. The PSAR provided acceptable information for seven of eight information areas identified in Section 4.6.3.3.1 of RL/REG-99-05 and conditionally acceptable information for one area. Evaluation of the information for each area is summarized below:

(i) Seismic Performance Categorization – The reviewers found acceptable the classification of the PT facility structures as SC-I based on their SDC classification and requirement to function during a seismic event. The classification was consistent with the requirements of SRD Safety Criterion 4.1-3.

(ii) Selection of Seismic Design Criteria, Seismic Hazard Curve, and Seismic Response Spectra – The reviewers found acceptable the analysis methods and design criteria, which are consistent with or more conservative than, those in DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4-1.1. The seismic hazard curve was based on a 1996 site-specific study performed by Geomatrix[136] for the Hanford Site and reviewed and accepted earlier by the OSR.[137] In 1999, as members of the TWRS Privatization Team, BNI personnel subsequently validated the study. The reviewers found the peak ground acceleration of 0.26 g and the DBE response spectra for the PT facility acceptable because they were consistent with the site-specific hazard curve and SRD Safety Criterion 4.1-3.

(iii) Seismic Analysis and In-Structure Spectra Development Methodology – The reviewers found acceptable the methods BNI used to perform a seismic analysis of the PT facility considering the effect of SSI during the design basis earthquake because the methods are consistent with DOE-STD-1020-94, ASCE 4-98, and SRD Safety Criterion 4.1-3. The design for the subsurface pits, tunnels, and basemat used the results of an SSI analysis based on a preliminary design of the PT facility. In response to conditions for acceptance in Revision 2 of this SER, BNI documented in an internal memorandum[138] this approach. The reviewers found this approach for pits, tunnels, and basemat to be acceptable. Design of the above-grade structure will use the results of a revised SSI analysis based on the current design of the PT facility. The reviewers found the treatment of seismic analysis and in-structure spectra development methodology acceptable as previously discussed in Section 4.3.1.2, Items 3(b) and 3(d), of this SER.

[136] *Probabilistic Seismic Hazard Analysis, DOE Hanford Site Washington*.
[137] 99-RU-0394, ORP letter from D. C. Gibbs to M. J. Lawrence, BNFL, "Acceptance of Peak Ground Acceleration (PGA) for the RPP-P facility Design Basis Earthquake," dated June 30, 1999.
[138] CCN: 044586, BNI internal memo, I. Ghosh/M. Axup, to D. Houghton, "Response to additional information, requested by OSR, in relation to the structural evaluation of the Pretreatment Below Grade Pits, Tunnels, and Basemat," dated November 19, 2002.

The reviewers found the method for developing the in-structure spectra for building supported SSC design to be acceptable because it was consistent with the requirements of SRD Safety Criterion 4.1-3 and implementing standards DOE-STD-1020-94 and ASCE 4-98.

(iv) Seismic Acceptance Criteria – The reviewers found the seismic acceptance criteria acceptable for full facility construction. The PSAR evaluated or referenced the design adequacy of the PT subsurface pits, tunnels, and basemat by calculating demand/capacity ratios using section capacities based on ACI 349-01 code provisions. The reviewers found this method to be acceptable because it was consistent with DOE-STD-1020-94 and SRD Safety Criterion 4.1-3. To account for the uncertainty resulting from not completing the final design, BNI reduced the capacity by 15% in computing the demand/capacity ratios. The reviewers found this method to be acceptable because it is conservative and further ensures that the acceptance criteria will be met. The reviewers found the methodology satisfied DOE-STD-1020-94 and ACI 349-01 for subsurface pits, tunnels, and basemat, thus demonstrating the adequacy of the methodology for full PT building construction authorization.

(v) Seismic Detailing and Anchorage Details – The reviewers found acceptable the commitment in PSAR Section 2.4.4.1 to detail reinforcing steel in the PT facility according to ACI 318-99, Chapter 21, "Seismic Design," because it was consistent with SRD Safety Criterion 4.1-3. The reviewers also found acceptable the commitment in PSAR Section 2.4.4.7 to design and detail anchorages according to ACI 349-01, Appendix B. Anchorage details were found to be acceptable as previously discussed in Section 4.3.1.2, Item 4, of this SER.

(vi) Evaluation of the Consequences of Beyond-the-Design-Basis Earthquake – The reviewers found the evaluation of the consequences of the beyond-the-design-basis earthquake to be acceptable for the PT facility. PSAR Section 3.6 presented the results of the seismic probabilistic risk assessment and showed that seismically induced radiological releases from the PT facility were very low compared with the risk goals (i.e., very small fraction of the goals). See Section 4.6 of this SER for detailed evaluation of the seismic probabilistic risk assessment.

(vii) Seismic Calculation Methods – The reviewers found acceptable BNI's method of calculating seismic demands and capacities because the method is consistent with DOE-STD-1020-94, ASCE 4-98, and ACI 349-01, as required by SRD Safety Criterion 4.1-3. (See also Section 4.3.1.2, Item 3[d] of this SER.) However, BNI performed the structural design of subsurface pits, tunnels, and basemat using design basis in-plane shears and out-of-plane bending moments for a series of static equivalent GTSTRUDL analyses and not those from an SSI analysis, as required by ASCE 4-98 and DOE-STD-1020-94. BNI compared the two sets of loads

(from the GTSTRUDL analyses and the preliminary SSI analyses) and concluded that the loads resulting from GTSTRUDL analyses envelope those from the SSI analyses. The reviewers found this comparison to be acceptable.

(viii) Safety and Operability Functions of the PT Facility – Reviewers found the description of the safety and operability functions of the PT facility structural components to be conditionally acceptable.

The basemat and subsurface pits and tunnels provide structural support to the rest of the facility, including all ITS and non-ITS SSCs during normal operations, abnormal events, and DBEs, including the design basis earthquake. Reviewers found this functional requirement of the basemat and subsurface pits and tunnels acceptable. Implementation of the design requirements in SRD Safety Criterion 4.1-3 for the design of the above-grade portion of the PT facility will ensure that those portions for which design is not complete will also perform the required structural functions.

PSAR Volume II also assumes that the facility structure acts as a secondary confinement. Reviewers questioned (Questions PT-PSAR-221 and -230) how cracks in the concrete resulting from normal concrete behavior, seismic loading, or drops of heavy items affect the ability of the PT structure to perform its confinement function. BNI responded that cracks due to seismic loading and normal concrete behavior will not impair the effectiveness as a confinement barrier because of the system of sloped floors and drainage that prevents significant accumulation of liquids against the facility walls. Based on the small liquid head across the wall and a comparison with structural and dose calculations performed for the HLW facility, the worst-case leak is not expected to exceed SL-3 consequences for the co-located worker. BNI also stated that drops of large items on floors above the basemat would not result in leakage of radioactive or hazardous materials into areas that pose a risk to the worker. Also, in response to Question PT-PSAR-246, BNI stated that implementing the design requirements in DOE STD-1020-94, in conjunction with an effective ventilation system, would ensure that required pressure differentials could be maintained. Reviewers found the above secondary confinement strategy acceptable and consistent with requirements of SRD Safety Criterion 4.1-3 and implementing standard DOE-STD-1020-94.

Reviewers found controls required to place the facility in a safe state following a seismic DBE to be conditionally acceptable. SRD Safety Criterion 4.1-3 requires, in part, that SDC and SDS SSCs be designed to withstand the effects of an earthquake without loss of capability to perform specified safety functions required as a result of the earthquake. Reviewers questioned (Question PT-PSAR-003) the lack of a commitment to seismic qualification of nine interlock functions described in the PSAR:

(a) The SDC evaporator interlock, which shuts down the evaporator to minimize the amount of radioactive contamination entering the condensate system

(b) The SDC gamma detection interlocks (described as seismically qualified in the HLW PSAR), which ensure that shield doors, personnel shielded access doors, and hatches remain closed to prevent operator entry into areas that may result in excessive radiation exposure

(c) The SDC interlocks (described as seismically qualified in the HLW PSAR) associated with the shield doors, personnel shielded access doors, and shielded hatches, which prevent multiple shield barriers from opening simultaneously and ensure that the secondary confinement function of the doors and hatches such as air locks is maintained

(d) The SDC nitric acid concentration monitor and interlock, which prevent the transfer of concentrated nitric acid into the cesium ion exchange columns during elution, which could produce large amounts of offgas and could release radioactive materials

(e) The SDC LAW concentrate vessel gamma monitor and interlock, which prevent the transfer of out-of-specification treated LAW to the LAW vitrification facility

(f) The SDS high-high level interlock on the ultimate overflow vessel, which prevents overfilling the vessel and flooding the pit with a radioactive slurry

(g) The SDS evaporator separator reboiler and heat exchanger radiation monitors and interlocks, which divert contaminated condensate away from facility workers

(h) The SDS primary cooling and chilled water head tank level detection and alarm system, which indicates reduction in differential pressure between the cooling or chilled water system and process vessel pressures

(i) The SDS cesium evaporator separator temperature monitor and interlock, which prevent over-concentration of nitric acid and the potential for large amounts of offgas and release of radioactive materials.

The BNI response to Question PT-PSAR-003 and reviewer evaluation was as follows. For the evaporator interlocks (items [a] and [g]), BNI stated that the feed evaporator, including the reboiler, is SC-I. No common-

cause mechanism has been identified that would induce evaporator overflow as a direct result of a seismic event, provided the feed and recirculation pumps were shut down in a timely manner. The specific event is a hazard to facility workers only. Although no credit is explicitly taken for worker evacuation in the current DBE analysis of seismic events, the building emergency response program will require that nonessential workers evacuate the facility shortly after a seismic event. Workers who remain in the facility either will be in the hardened main control room or will be required to wear appropriate personnel protective equipment (e.g., respirators). The reviewers found that this response clarified the design basis and was consistent with the SRD and therefore was acceptable.

For the gamma detector and access interlocks (items [b] and [c]), BNI stated that the seismic qualification for these interlocks would be consistent with the similar interlocks at the HLW facility. At a minimum, the shield doors and hatches will be required to fail in their last position on a seismic event. BNI stated that this information and necessary revisions to the seismic qualifications of these interlocks would be incorporated into the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

For the interlocks providing worker protection during transfers (items [d], [e], and [i]), BNI stated that no common-cause mechanism has been identified that would induce a spurious regeneration cycle or LAW waste transfer as a result of a seismic event. Therefore, unless regeneration or transfer was already in progress when the event occurred, the effect of the earthquake would only be to disable these interlocks. However, because the interlocks were satisfied before the event (e.g., for acceptable acid concentrations and evaporator temperature) the potential for out-of-specification conditions to develop before the emergency shutdown can be considered was beyond extremely unlikely. The reviewers found this response acceptable.

For the interlocks on the ultimate overflow vessel (item [f]), BNI stated that no common-cause mechanism had been identified that would initiate a spurious vessel filling operation as a result of a seismic event. However, if a transfer were in progress at the time of the earthquake, the potential exists that operators would be unable to stop the transfer using normal (non-seismic) process controls. In this case, the volume of the overflow collection vessels and the hot cell pit are sufficient to contain the overflow for the time required to implement emergency procedures to stop all transfers. Notwithstanding that this consequence is acceptable as described by BNI, the reviewers noted in Question PT-PSAR-003 that this would be an exception to PSAR Table 3A-27, which stipulated that seismic events do not induce overflow. In response, BNI stated that PSAR Table 3A-27 would be revised to include the above strategy in the first

PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

For the interlocks associated with cooling water (item [h]), BNI stated that the process cooling water systems are not required to remain functional following a seismic event. The potential for gross contamination of these systems as a result of seismic damage to the cooling system interfaces with process liquor (e.g., cesium ion-exchange heat exchangers) is minimized by designating these interface points as SC-I. The reviewers found this clarification of the design basis consistent with the SRD and therefore acceptable.

(c) **Other External Events**– The reviewers found the information on the definition of other external events for the PT facility acceptable for all criteria. The reviewers evaluated the six considerations described in Section 4.6.3.3.2 of RL/RG-99-05.

(i) The reviewers found the selection of the PC-3 design basis wind as well as the calculation methodology acceptable because they were consistent with the requirements of DOE-STD-1020-94 and Table 4-1 of SRD Safety Criterion 4.1-3. BNI used a design wind speed of 111 mph in calculation report 24590-PTF-S0C-S15T-00011 and used ASCE 7-98 methodology to calculate pressures resulting from the design basis wind.

(ii) Reviewers found the selection of the design basis wind-driven missile acceptable because it was consistent with the requirements of DOE-STD-1020-94 and Table 4-1 of SRD Safety Criterion 4.1-3. PSAR Section 2.4.3.6 indicated that the PT building was being designed for a 15-lb timber plank missile with a velocity of 50 mph, striking the facility at 30 ft above grade.

(iii) The reviewers found the PSAR statement that river flooding was not applicable for the PT building acceptable because, as stated in PSAR Section 1.4.2.1, floods do not directly impact the WTP because of its location above the maximum postulated flood level.

(iv) The reviewers found the selection of the design basis ashfall loading of 12.5 lb/ft^2 for a PC-3 facility (per 24590-PTF-S0C-S15T-00011) and its application in PT structural design acceptable because it was consistent with Table 4-1 of SRD Safety Criterion 4.1-3. BNI considered ash loading concurrently with roof live loading and showed that the facility met the applicable design requirements for withstanding loading due to ash load. Also, see the discussion of common-cause/common-mode failures for external events, including ashfall, in Section 4.3.3, Item 5, of this SER.

(v) The reviewers found the selection of the design basis snow loading of 15 lb/ft^2 for a PC-3 facility (per 24590-PTF-S0C-S15T-00011) and its application in PT structural design acceptable because it was consistent with ASCE 7-98 and Table 4-1 of SRD Safety Criterion 4.1-3. As allowed by ASCE 7-98 for load combinations, BNI considered snow loading not to be concurrent with roof live loading and showed that the facility met the applicable design requirements for withstanding loading due to snow.

(vi) The impact of an accidental aircraft crash onto the PT building was evaluated by BNI in 24590-WTP-Z0C-50-00001, Revision C. BNI used the methodology and criteria given in DOE-STD-3014-96 for this analysis. The reviewers found the use of this standard acceptable because it provides guidance and data specific to DOE facilities. BNI chose to use exposure screening for the public. It was assumed that each vessel is filled to the highest operating level with the process stream with the highest unit dose that could be in that vessel and that the aircraft crash could cause a release from all vessels (i.e., no structural evaluation was performed; the structure was not credited). This bounding dose was calculated to be 19 rem, less than the 25 rem screening criterion and the WTP radiation exposure standard for the public receptor per SRD Safety Criterion 2.0-1. Reviewers found the evaluation for aircraft crash events acceptable.

7. **Defining the Operating Environment** – The reviewers found the description of the operating environment for the PT facility to be conditionally acceptable. The definition of operating environment addressed the parameters required by the SRD, Appendix A, Section 4.7, "Definition of Operating Environment," except as noted in the following two paragraphs. PSAR Table 3A-10 listed parameters including pressure, temperature, humidity, radiation, chemical conditions, and submergence in affected parts of the facility following the occurrence of each analyzed DBE. The only significant environmental impacts caused by a DBE inside the facility were the elevated temperature in the truck bay following a fire there and high radiation in C5 ventilated areas (from any accident). DBEs with the potential to cause high-energy releases and large impacts on post-accident environmental conditions, i.e., vessel boiling, cesium ion exchange column events, and H_2 explosions, are prevented by the selected control strategies.

The potential for submergence following liquid spill events is discussed in Item 5 above in the context of internal flooding. The potential for high humidity/moist environments from a steam line rupture event and potential impacts to C5 ventilation is discussed in Item 4 of Section 4.3.3.2 of this SER.

The reviewers questioned (Question PT-PSAR-210) how the potential effects of exposed electrical conductors exacerbate the consequences of chemical reactions or aerosol distribution in the hazard analyses. BNI stated that these potential effects would be minimized by (1) using cable having an overall jacketing resistant to chemicals and (2) installing electrical conductors in galvanized rigid steel or flexible conduits with a protective coating such as PVC or epoxy. Conductor terminations will be contained in a

suitable enclosure for the anticipated harsh environment. Items needing a coating will be identified by engineering on design documents and reflected in coating specifications. Reviewers found this clarification of the design basis for electrical conductors acceptable.

8. **Identifying Potential Control Strategies** – The reviewers found the PSAR's identification of potential control strategies for mitigating consequences of the selected DBEs conditionally acceptable. The PSAR identified 18 SDC and 12 SDS SSCs as preventive or mitigative control strategy elements. The PSAR listed the ITS SSCs in Tables 4A-1 (SDC) and 4A-2 (SDS) along with brief descriptions of credited safety functions, representative bounding accidents for which they are credited, and controls provided to protect the safety functions. The reviewers evaluated PSAR Sections 3.3 and 3.4 and the Appendix A CSD records, including control strategy elements and safety case requirements identified in the CSD records in the PSAR and the results of the selection of hazard control strategies for DBEs in 24590-PTF-RPT-ESH-02-002. The evaluation focused on the description of the potential hazard control strategies that were identified to control potential accidents as well as the final control strategies selected for the analyzed DBEs.

Reviewers found the control strategies generally acceptable; however, they had the following concerns. The SRD, Appendix B, Table B3-1, requires two or more physical barriers for SL-2 events. PSAR Section 3.4.1.1.2.7 documented a DBE for a drop of a cask containing a plugged ultrafilter to the floor of the truck export bay with SL-2 unmitigated consequences to the co-located worker. Reviewers questioned (Question PT-PSAR-074) the identification of RRC hoisting equipment as the first physical barrier credited to prevent or mitigate the consequences of the drop. In response to Question PT-PSAR-074, BNI stated that the cask and sealed metal container (usually a 55-gallon drum) placed in the cask would provide two physical barriers. The cask is designed to withstand a drop from the highest possible lift in the truck bay. Therefore, reliance on special features for the crane is not required. In the response, BNI committed to revise the PSAR in the first revision following authorization for full facility construction to reflect the revised control strategy. Reviewers found the revised strategy consistent with the SRD, Appendix B, and the commitment acceptable.

PSAR Section 3.4.1.11.1.1 discussed failure of separation between process vessels and cooling water jackets. The PSAR further states that the hydraulic head in a standpipe in the cooling water system will normally ensure that contamination cannot leak from a process system into the chilled water system. Reviewers questioned (Question PT-PSAR-042) how the hydraulic head in the standpipe could keep the cooling water system pressure above the cesium and technetium ion-exchange column operating pressure. In response, BNI stated the hydraulic head of the standpipe is not sufficient to provide the overpressure requirements across the cooling water jackets in these vessels. BNI committed to add redundant chilled water booster pumps and associated ITS instrumentation and controls to the cooling water supply header for the cesium and technetium in line heat exchangers to meet the required design criterion to have cooling water pressure greater than vessel pressure. The added booster pumps will maintain a cooling water pressure of about 10 lb/in.^{2} higher than the process pressure. BNI further stated the PSAR would be revised to describe the chilled water booster pump system in

the first revision following authorization for full facility construction. The reviewers found this commitment acceptable.

9. **Documenting the Hazard Evaluation** – The reviewers found the documentation of the facility hazard evaluation of the PT facility to be conditionally acceptable. As required by the SRD, Appendix A, Section 4.9, "Documentation," and DOE/RL-96-0003, Section 4.3.2, "Contractor Input," BNI is required to provide a PSAR that adequately describes SSCs and associated hazards in the PT facility. Reviewers noted many inconsistencies in documentation among the PSAR Appendix A and supporting calculations, reports, and drawings. In responses to several Questions (Questions PT-PSAR-270, -271, and -275), BNI stated that it would make changes to correct SSC descriptions and inconsistencies in the PSAR, referenced drawings, and DBE calculations in the first revision to the PSAR following authorization for full facility construction. While these errors made review of the PSAR more difficult and less efficient, they did not impact the reviewers' conclusion that the hazard and accident analyses of the proposed preliminary design was conditionally acceptable. The reviewers found BNI's commitments to correct SSC descriptions and other PSAR errors acceptable.

4.3.2.3 Conclusions

The reviewers concluded that the hazard and accident analysis in the PSAR for the PT facility was conditionally acceptable. The hazards information, as supplemented by information in responses to reviewer questions and BNI calculations, was consistent with the current status of the facility and process design. With the exceptions identified below, the radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, were adequately assessed and sufficient preventive or mitigative features were identified.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Perform a hazard analysis for water hammer and consider water hammer loads in the design of piping supports in the ISM Cycle III hazard topography process and document the results in the following annual PSAR update, as committed to in response to Question PT-PSAR-276. (See Section 4.3.2.2, Item 1.)

2. Analyze the release rate and ammonia concentration and document the result in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-199. (See Section 4.3.2.2, Item 1.)

3. Develop and include a basis for the frequency and locations of periodic flushing (if needed) of vent lines to prevent ammonium nitrate buildup and determine the need for inspection ports in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-290. (See Section 4.3.2.2, Item 1.)

4. Revise discussions in the PSAR pertaining to sampling to eliminate inconsistencies and incorporate administrative controls described in the LAW and HLW sections of the PSAR for sampling required to protect the LAW and HLW facilities in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-333. (See Section 4.3.2.2, Item 1.)

5. Verify that design features for diluting sodium permanganate are inherent using Revision 0 design media, and if necessary, include an ITS permanganate concentration monitor in the design or a TSR to preserve minimum heel volumes in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-025. (See Section 4.3.2.2, Item 2.)

6. Revise severity level calculations and DBE calculations to account for ^{241}Am concentrations at Contract maximum in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-029. (See Section 4.3.2.2, Item 3.)

7. Incorporate changes to DBE calculations, seismic probabilistic risk analysis, operation risk assessment, and the PSAR resulting from reconfiguration of shear walls to address seismic forces and resizing of HLP system vessels in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-256. (See Section 4.3.2.2, Item 3.)

8. Revise hydrogen generation rates and severity level analysis in the first revision of the PSAR following authorization for full facility construction to do the following:

   (a) Revise the calculation in 24590-PTF-Z0C-W14T-00002, *Revised Severity Level Calculation for the Pretreatment Facility*, to more conservatively account for the concentration of the nitrate/nitrite ions by using Equation 2-3 from RPT-W375-SA00002, *Topical Report on the Management of Risks Posed by Explosive Hazards Present at the RPP-WTP*. This was committed to in response to Question PT-PSAR-023. (See Section 4.3.2.2, Item 3[a].)

   (b) Perform all hydrogen generation rate calculations for tanks that could self-boil within 300 hours using a maximum temperature of 220°F and increased activation energy (100 kJ/mole), as committed to in response to Question PT-PSAR-336. (See Section 4.3.2.2, Item 3[a].)

   (c) Designate hydrogen deflagration events to be SL-1 for all receptors, as committed to in response to Questions PT-PSAR-024 and -028. (See Section 4.3.2.2, Item 3[a].)

   (d) Evaluate the potential for piping systems and ancillary equipment to accumulate hydrogen as well as potential control strategies, as committed to in response to Question PT-PSAR-289. (See Section 4.3.2.2, Item 3[a].)

(e) Finalize calculations to verify that the instrument air supply rate and noncondensed steam conditions are sufficient to keep the evaporators below 25% of the lower flammability limit in the offgas systems, as committed to in response to Question PT-PSAR-293. (See Section 4.3.2.2, Item 3[a].)

9. Develop administrative controls during ISM Cycle III to prevent hydrogen buildup in vessels containing low liquid levels when pulse jet mixers are automatically stopped and document the results in the FSAR, as committed to in response to Question PT-PSAR-294. (See Section 4.3.2.2, Item 3[a].)

10. Correct calculation errors documented in Questions PT-PSAR-023, -042, -199, -258, and -259, as committed to in response to these questions in the first revision of the PSAR following authorization for full facility construction. (See Section 4.3.2.2, Item 3[a].)

11. Reconsider the need for the emergency elution system in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-025. (See Section 4.3.2.2, Item 3[b].)

12. Delete references to target frequencies in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Questions PT-PSAR-051, -052, -055, -125, -127, and -211. (See Section 4.3.2.2, Item 4.)

13. Evaluate the flooding hazard for ITS equipments (both electrical and mechanical) as part of the hazard topography evaluation scheduled during ISM Cycle III and document results in the PSAR annual updates, as committed to in response to Question PT-PSAR-256. (See Section 4.3.2.2, Item 5.)

14. Address failure of the temperature control system or a steam supply valve in the ultrafiltration feed tank in the DBE boiling calculation in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-198. (See Section 4.3.2.2, Item 6[a].)

15. Develop a separate tank bump DBE analysis and document the results in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-098. (See Section 4.3.2.2, Item 6[a].)

16. Include the revised DBE analysis for leaks in the transfer line between the tank farms and the PT facility in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-055. (See Section 4.3.2.2, Item 6[a].)

17. Document that shield doors and hatches will be required to fail in their last position on a seismic event. This information and necessary revisions to seismic qualification of these interlocks shall be incorporated in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-003. (See Section 4.3.2.2, Item 6[b][viii].)

18. Revise Table 3A-27 of the PSAR to reflect that the volume of the overflow collection vessels and the hot cell pit are sufficient to contain the overflow for the time required to implement emergency procedures to stop all transfers. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-003. (See Section 4.3.2.2, Item 6[b][viii].)

19. Revise the PSAR to reflect that the cask and sealed metal container placed in the cask would provide two physical barriers credited to mitigate the consequences of a load drop in the truck bay. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-074. (See Section 4.3.2.2, Item 8.)

20. Add a description of redundant chilled water booster pumps and associated ITS instrumentation and controls to the cooling water supply header for the cesium and technetium in line heat exchangers to meet the required design criterion to have cooling water pressure greater than vessel pressure. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-042. (See Section 4.3.2.2, Item 8.)

21. Correct SSC descriptions and inconsistencies in the PSAR, referenced drawings, and DBE calculations in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Questions PT-PSAR-270, -271, and -275. (See Section 4.3.2.2, Item 9.)

4.3.3 PT Important-to-Safety SSCs

The purpose of this review was to determine whether the PSAR adequately identified the PT facility ITS SSCs and the most severe anticipated conditions under which they must function.

4.3.3.1 Requirements

The requirements for the PT facility ITS SSCs were the same as those listed in Section 3.4.1 of this SER but as applied to the PT facility. The SRD, Appendix A, Section 4.7, "Definition of Operating Environment," and RL/REG-99-05, Section 4.5.3, "Defining Operating Environment and Performance Requirements," identified the specific requirements.

The reviewers evaluated whether the PSAR adequately determined and documented each PT facility ITS SSC, using the six elements described in Section 3.4.1[139] of this SER: (1) SSC identification, (2) safety function, (3) system description, (4) functional requirements, (5) system evaluation, and (6) controls (TSRs). The submittal for the PT facility must also identify the most severe environmental conditions under which PT ITS SSCs must function, including temperature, pressure, humidity, radiation level, and chemical environment.[140] The hazard

[139] RL/REG-99-05, Section 4.5.3.3.3, "Regulatory Acceptance Criteria."
[140] SRD, Appendix A, Section 4.7, "Definition of Operating Environment."

control strategies selected must be shown to be consistent with the most severe identified environmental conditions.

Additional information on the review of TSRs is contained in Section 4.3.4 of this SER.

4.3.3.2 Evaluation

The reviewers found the identification of PT SSCs related to the PT facility conditionally acceptable. The PSAR methods and selection criteria for ITS SSCs were documented in PSAR Volume I, *General Information*, Chapter 4, and the safety review documented in Section 3.4 of this SER.

The PSAR included three designations for ITS SSCs: SDC, SDS, and RRC. The concept of RRC as a subset of ITS items was presented, concurrently with the PSAR, in 24590-WTP-ABCN-ESH-01-029.[141] In 24590-WTP-ABCN-ESH-01-029, which revised SRD Safety Criterion 1.0-8, RRC SSCs were defined as all ITS SSCs that were neither SDC nor SDS. BNI also proposed that the implementing standards for performance requirements on RRC SSCs would be further identified by applying the SRD, Appendix A, "Implementing Standard for Safety Standards and Requirements Identification." The concept of RRC as a subset of ITS items was accepted with the approval of 24590-WTP-ABCN-ESH-01-029.

Reviewers questioned (Question PT-PSAR-243) how standards would be identified for RRC SSCs. In response, BNI stated that the evaluation of the RRC SSCs to the requirements of the SRD, Appendix A, would be completed using the ISM process. This was acceptable to the reviewers because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazards and accident analysis results documented in the PSAR and would not be expected to result in significant changes to the facility design or safety conclusions.

The reviewers found two of the six criteria to be acceptable and four to be conditionally acceptable. The evaluation of the information for each review criterion is summarized below:

1. **SSC Identification** – The reviewers found the identification of SSCs to be conditionally acceptable. SSCs designated SDC and SDS were identified and described in PSAR Volume II, Chapter 4. RRCs were identified in Table 3A-8, "PT Risk Reduction Class Items Systems." SDC SSCs were appropriately identified and documented in PSAR Volume II, Section 4.3, according to SRD Appendix B, "Implementing Standards for Defense in Depth." The following SSCs were designated SDC:

    - Facility structures
    - C5 area ventilation system

[141] CCN-038768, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Approval – Authorization Basis Change Notice 24590-WTP-ABCN-ESH-01-029, Revision 1, Addition of Risk Reduction Class (RRC) Items to SRD," dated August 26, 2002.

- Vessels, evaporator/separators, and cesium IX columns (H_2 hazards)
- Hydrogen purge and mixing systems
- Transfer lines and process piping
- Process vessel cooling jackets and evaporator/separator reboilers and heat exchangers
- Access controls (interlocks)
- LAW concentrate vessel gamma monitor and interlock
- Cesium ion exchange column liquid level protection systems
- SDC electrical power
- Shielded transport cask
- Process vessel ventilation systems (filtration)
- Bulge shielding
- Nitric acid concentration monitor and interlock
- Hot cell drain system
- Evaporator/separator shutdown interlocks
- Cesium ion exchange process and cesium nitric acid recovery process systems
- Process vessels (non-H_2 hazards).

By examining the DBEs described in the PSAR and the hazard and accident analysis results related to those DBEs, the reviewers concluded that all SDC SSCs were acceptably defined and described. Specifically, the reviewers concluded that the list of SDC equipment was complete and that the safety function of each SSC was clear and adequate. In addition, the system description for the hazard controls, their functional requirements, applicable standards, and draft operational controls (TSRs) combined to adequately control the hazards associated with the DBEs.

SDC instrumentation and control applications included support of the following PT functions: C5 area ventilation; hydrogen purge and mixing, access control interlocks, LAW concentrate vessel gamma monitor and interlock, cesium ion exchange column liquid level protection, nitric acid concentration monitor and interlock, and evaporator/separator shutdown interlocks.

The following SSCs were designated SDS:

- Shield doors and shielded hatches
- C3 area ventilation system (filtration)
- High-high level interlock on the ultimate overflow vessel
- Primary cooling and chilled water head tank level detection instrumentation and alarms
- Evaporator separator reboiler and heat exchanger radiation monitors and interlocks process vessel cooling water monitoring and isolation
- Vessel overflow piping
- Cranes, lifting devices, and cable reel flame barriers
- Pulse jet ventilation system (filtration)
- Process bulge enclosures, and drain and ventilation piping
- Remote sampling system
- Main control room standby ventilation system
- Cesium evaporator separator temperature monitor and interlock.

The reviewers found the identification of SDS SSCs acceptable because it was consistent with the SDS safety functions credited for the internal and external DBEs analyzed in Section 3.4 of the PSAR.

SDS instrumentation and control applications included support of the following PT functions: high-high level interlock on the ultimate overflow vessel; primary cooling and chilled water head tank level detection and alarms; evaporator separator reboiler and heat exchanger radiation monitors and interlocks; main control room standby ventilation; and cesium evaporator separator temperature monitor and interlock.

The following SSCs were identified in PSAR Table 3A-8 as RRC:

- Vessels (with hazardous contents and not designated SDC or SDS)
- Vessel level alarm controls (if not designated SDC or SDS)
- Radiation monitor in process cooling and chilled water lines for process vessels with cooling jackets

- Interlock with radiation monitoring in cooling and chilled water loop isolation valves
- Liners, sumps, sump level detection and alarms, and ejectors
- Cesium IX column gas separation vessel normal level control system
- Cesium IX column temperature monitoring system
- Cesium IX column feed pump trip interlock
- Out-cell cranes.

The reviewers noted that, although ITS, the SSCs designated RRC were not identified in Chapter 4 and were not identified consistently in PSAR Table 3A-8 and Appendix A. In addition, based on the definition of RRC SSCs in the approved version of 24590-WTP-ABCN-ESH-01-029, the identification of RRC SSCs in the PT PSAR was not complete according to the requirements of the SRD, including SRD Safety Criteria 1.0-8, 4.2-2, and 4.2-4.

Reviewers questioned (Questions PT-PSAR-239 through -242), why several SSCs were listed in Appendix A of the PSAR as RRC but not included in Table 3A-8. In response to the questions, BNI stated the referenced SSCs should have been included in Table 3A-8. BNI committed to identify RRC SSCs and correct the list of identified RRC SSCs in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazards and accident analysis results documented in the PSAR and would not be expected to result in significant changes to the facility design or safety conclusions.

2. **Safety Function** – The reviewers found the identification of the safety functions in Chapter 4 of the PSAR acceptable for SDC and SDS SSCs. The chapter included a section that described the credited safety function for each SDC and SDS SSC. Reviewers found the identification of safety functions for RRC SSCs conditionally acceptable as discussed below.

   The reviewers found that the safety functions of the SSCs designated RRC were described adequately in PSAR Volume II, Table 3A-8. However, as noted in Item 1 above, the list of RRC SSCs in Table 3A-8 did not include all ITS SSCs that were not designated as either SDC or SDS in PSAR Chapter 4 (as described in the preceding paragraphs of this SER). BNI committed to include a complete list of RRC SSCs, with associated safety functions in its responses to Questions PT-PSAR-239 through -242, with the first PSAR revision following authorization for full facility construction. The reviewers found these commitments acceptable.

3. **System Description** – The reviewers found acceptable the system descriptions of SSCs designated SDC and SDS, as described in PSAR Chapter 4. The chapter included a

section that described each SDC and SDS SSC identified. The reviewers found the descriptions to be complete and adequate. The reviewers concluded that the system descriptions for SDC and SDS SSCs were consistent with the requirements of the SRD.

The PSAR did not include system descriptions for RRC SSCs. Reviewers found this acceptable because the SRD does not require system descriptions for RRC SSCs in the PSAR. RRC SSCs are, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazard and accident results documented in the PSAR, and detailed descriptions of RRC SSCs are not required to adequately document the facility safety basis.

4. **Functional Requirements** – The reviewers found the functional requirements of SSCs designated SDC and SDS, as described in PSAR Chapter 4, to be conditionally acceptable. For each SDC and SDS SSC identified, the chapter included a section that described the functional requirements of the SSC, according to the SRD, Appendix A, Section 4.7, "Definition of Operating Environment." However, some information on the functional requirements of ITS SSCs in the PSAR was incomplete or required clarification, as discussed below.

In consideration of SRD Safety Criterion 4.2-1, reviewers questioned (Questions PT-PSAR-260, -295, and -298) the impacts of off-normal events such as earthquakes, fires, and loss of site power on the ability of the PT process equipment and control systems to prevent overfilling the overflow pit while maintaining the fire protection function. In response, BNI stated that the high-high level trip for PWD-VSL-00033 (the ultimate overflow vessel located in the overflow pit) would isolate all feeds that originate in vessels capable of producing an SL-1 event, thereby preventing overflow to the overflow pit when site power is available. The list of feeds isolated by the ultimate overflow vessel high-high level trip will be verified by engineering when the design is firmer. BNI also stated no components were identified that would continue to add feed to the PT facility on loss of site power, except for firewater, if it has been automatically or manually activated. BNI also stated that in the event the PT facility must be evacuated, automatic refilling of the firewater and BOF tanks would be terminated according to emergency operating procedures. This would prevent the uncontrolled addition of excessive water to the PT facility. The reviewers found these clarifications acceptable because the PT control room is designed to remain habitable following the design basis earthquake and other events, thereby ensuring personnel are available to perform the emergency procedures.

In consideration of SRD Safety Criteria 4.2-1, 4.2-2, and 4.2-3, reviewers questioned (Questions PT-PSAR-288 and -291) the ability of the ventilation systems to accommodate pressure and mist loading on the HEPA filters under pulse jet mixer overblow conditions. In response, BNI provided information on design margins and referenced calculation report 24590-PTF-Z0C-10-00002 to demonstrate the capability of the ventilation systems to accommodate these conditions. Reviewers found this information acceptable.

The reviewers also questioned (Question PT-PSAR-287) the ability of the C5 ventilation system to accommodate mist loading on HEPA filters due to rupture of the low-pressure

steam lines that feed the evaporator reboilers. In response, BNI stated that water-saturated air caused by a break in the evaporator steam line will be mixed with enough dry air from other C5 cells before it reaches the primary C5 ventilation system filters to preclude exceeding moisture limitations. BNI committed to confirming this conclusion in a DBE calculation to be documented in the PSAR in the first revision following authorization for full facility construction. The reviewers found this response acceptable because of the low probability that the calculation will show unacceptable mist loadings and because controls for rapidly responding to a large steam leak can be easily implemented if necessary.

In consideration of SRD Safety Criteria 4.2-1, 4.2-2, and 4.2-3, reviewers questioned (Question PT-PSAR-297) whether pressurized radioactive liquids could back up into certain C3 areas that are normally safe for human occupancy. Specifically, reviewers questioned controls for flooding of bulges and the adequacy of drain sizing. In response to PT-PSAR-297, BNI stated that in the unlikely event that a bulge process pipe leak exceeds the outflow rate provided by the 2 in. drain, the vent line would function as a secondary drain path. BNI committed to evaluate use and proper sizing of the bulge vent line to supplement drain capacity as part of the PSAR control strategy to provide bulge drains before bulge procurements are complete. The reviewers found this commitment acceptable because it will provide added assurance that the PSAR Chapter 4 functional requirement for process bulge drains and ventilation extract pipes are sized to provide an unobstructed pathway for liquid releases from the bulge enclosure to the C5 area. Evaluations and designs of drain systems will be completed in time to avoid construction impacts.

5. **System Evaluation** – The reviewers found the system evaluations of SSCs designated SDC and SDS, as described in PSAR Chapter 4, to be conditionally acceptable, according to the SRD, Appendix A, Section 4.7, "Definition of Operating Environment." For each SDC and SDS SSC identified, the chapter included a section that evaluated the functional requirements versus the proposed design information for the SSC and integrated safety systems. The reviewers found the evaluations to be complete and adequate. The reviewers concluded that the system evaluations for SDC and SDS SSC were consistent with the requirements of the SRD.

SRD Safety Criterion 4.5-5 requires, in part, that redundant SDC systems and components be in separate fire areas. Neither the PSAR nor the analysis of the PT fire DBE, 24590-PTF-Z0C-W14T-00023, addressed the potential for the initiating fire to disable or degrade the depression and cascade airflow function for which credit was taken as a barrier. The PFHA stated that each of the C5 fans and its respective switchgear are separated by a two-hour rated fire barrier. However, for the connecting circuits, the general application of IEEE 384-1992 cited in the PSAR for the separation of C5 power and control circuits would not necessarily ensure that the circuits would be located in separate fire areas as required by Safety Criterion 4.5-5. The reviewers questioned (Question PT-PSAR-002) what design features would prevent the initiating fire from disabling or degrading the depression and cascade airflow provided by the C5 exhaust system, including the cascade trip circuits. The reviewers also questioned if redundant circuits for C5 SSCs, including cascade trip circuits and trip actuation devices for the

C3/C2 fans, were located in separate fire areas to satisfy Safety Criterion 4.5-5. In response, BNI stated a design basis fire will not result in loss of more than one C5 exhaust fan or in ventilation flow in C5 areas required to meet minimum flow and cell depression requirements. To achieve this, BNI stated the automatic start of a backup fan function would be preserved during a design basis fire. The reviewers found this clarification of the safety and design basis consistent with Safety Criterion 4.5-5 and acceptable.

The reviewers questioned (Question PT-PSAR-008) an inconsistency between BNI calculation report 24590-PTF-Z0C-10-00005, the DBE analysis presented in PSAR Section 3.4.1.11.4 and the description of the radiation monitors and interlocks presented in PSAR Section 4.4.5 for minimizing contamination in the evaporator/condensate systems. To meet SRD Safety Criterion 4.3-2, this instrumentation was assumed to be redundant in the governing DBE calculation but was not described as such in the PSAR. In response, BNI committed to revise the PSAR to be consistent with the DBE calculation in the first revision following authorization for full facility construction. The reviewers found this commitment acceptable.

The PSAR did not include system evaluations for RRC SSCs. Reviewers found this acceptable because the SRD does not require system evaluations for RRC SSCs. RRC SSCs are, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazard and accident results documented in the PSAR, and detailed descriptions of RRC SSCs are not required to adequately document the facility safety basis.

Reviewers questioned how the WTP ITS SSCs complied with SRD Safety Criterion 4.1-3 and SRD Appendix A criteria for considering common-cause/common-mode failures for external events, including the impact of volcanic ashfall. Reviewers questioned (Question PT-PSAR-257) whether ITS components and systems that require air cooling or intake air would perform their safety functions during and following an ashfall event. In response, BNI committed to analyze the potential effects on ventilation and air-cleaning SSCs of common-cause external events, such as volcanic ashfall, and document the results in the first PSAR revision following completion of the analysis and FSAR for the WTP facilities. BNI also stated that reasonable provisions will be provided to rapidly replace loaded filters, water washdowns, or other means to ensure that ventilation systems can maintain confinement and that backup air supplies remain operable. The reviewers found this commitment acceptable because it was appropriate for the preliminary design detail.

6. **Controls (TSRs)** – Section 4.3.4 of this SER addresses the adequacy of the draft TSRs provided in the PSAR. The reviewers evaluated the adequacy of the TSRs for ITS SSCs even though only draft TSRs were required at this time. The reviewers ensured that required TSRs for the SSCs were adequately addressed in the PSAR. The reviewers found the draft TSRs were consistent with the identification of ITS SSCs and appropriate for the controls identified and therefore were acceptable.

4.3.3.3 Conclusions

The reviewers concluded that the PSAR was conditionally acceptable for identifying ITS SSCs to implement the hazard control strategies.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Identify RRC SSCs and correct the list of identified RRC SSCs in the first PSAR revision following authorization for full facility construction, as committed to in response to Questions PT-PSAR-239 through -242. (See Section 4.3.3.2, Item 1.)

2. Include a complete list of RRC SSCs with associated safety function in the first PSAR revision following authorization for full facility construction, as committed to in response to Questions PT-PSAR-239 through -242. (See Section 4.3.3.2, Item 2.)

3. Confirm in a DBE calculation that water-saturated air caused by a break in the evaporator steam line will be mixed with enough dry air from other C5 cells before it reaches the primary C5 ventilation system filters to preclude exceeding moisture limitations or propose alternate controls. This will be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-287. (See Section 4.3.3.2, Item 4.)

4. Evaluate use and proper sizing of the bulge vent line to supplement drain capacity as part of the PSAR control strategy to provide bulge drains before bulge procurements are complete, as committed to in response to Question PT-PSAR-297. (See Section 4.3.3.2, Item 4.)

5. Update the PSAR to be consistent with DBE calculation report 24590-PTF-Z0C-10-00005, *Design Basis Event – Pretreatment Loss of Contamination Control*, to specify redundant radiation monitors and interlocks for minimizing contamination in the evaporator/condensate systems in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-008. (See Section 4.3.3.2, Item 5.)

6. Analyze the potential effects on ventilation and air-cleaning SSCs of common-cause external events, such as volcanic ashfall, and document the results in the first PSAR revision following completion of the analysis, as committed to in response to Question PT-PSAR-257. (See Section 4.3.3.2, Item 5.)

4.3.4 PT Facility TSRs

The purpose of this review was to determine whether the submittal adequately described appropriate draft TSRs for the hazard control provisions and strategies for the PT facility according to the applicable requirements of the Contract. The review should also determine

whether the PSAR Volume II adequately provided the basis for developing the TSRs to ensure that the facility will operate within the analyzed safety basis.

4.3.4.1 Requirements

SRD Safety Criterion 9.2-2 states, "Technical safety requirements shall be based on the FSAR and any facility-specific commitments made." The BNI Contract, Table S7-1, provides the requirement for submitting draft TSRs and states that draft TSRs will be submitted with the CAR. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item A.18.c, requires that the PSAR requesting construction authorization include a draft of the TSRs. The SRD defines the content of the TSRs. SRD Safety Criterion 9.2-1 states that TSRs shall be prepared and submitted for approval, and the facility shall be operated according to the approved TSRs. SRD Safety Criterion 9.2-3 describes the standard for TSRs, consisting of safety limits (Item 1) and limited control settings (Item 2a), each of which was further defined in the SRD. Finally, SRD Safety Criterion 9.2-4 states that TSRs shall be kept current at all times so that they reflect the facility as it exists and as it is analyzed in the safety analysis report.

4.3.4.2 Evaluation

BNI's PT submittal included draft TSRs that provided information commensurate with the current preliminary stage of facility design. These included limiting conditions of operation; associated surveillance requirements, mostly to be determined; administrative controls; bases, also mostly to be determined; and design features. The review of the draft TSRs was limited to evaluations to (1) confirm that safety functions derived in PSAR Section 3.4 were carried forward to form the basis for the TSR derivations in PSAR Chapter 5.0 and (2) confirm the consistency between Chapter 5.0 and the draft TSRs.

The reviewers found that the draft TSRs demonstrated proper application of the process to ensure that "The radiological, nuclear, and process hazards associated with facility operation, including those from postulated accidents, have been … sufficiently controlled/ mitigated … to establish a basis for safe operation and an unambiguous definition of the safe-operating envelope." Specifically, limiting conditions of operation and surveillance requirements were identified to protect the active safety functions of ITS SSCs; design features were identified to protect passive safety functions by maintaining the configurations assumed in the hazard and accident analyses; and administrative controls were defined to describe safety management programs. As noted in Section 3.5 of this SER, the reviewers found the draft TSRs acceptable. Detailed review leading to approval of TSRs will be performed along with the review of the FSAR before facility operation is authorized.

4.3.4.3 Conclusions

The reviewers concluded that the draft TSRs provided with the PT PSAR were commensurate with the preliminary design and were acceptable for authorization for full PT facility construction.

4.4 Balance of Facility

The BOF activities in PSAR Volume V covered construction of the facilities and systems required to support the PT, LAW and HLW vitrification and Analytical Laboratory facilities. This SER evaluates the initial portion of PSAR Volume V, referred to as BOF-1, and the additional portions of PSAR Volume V, referred to as BOF-2, submitted to ORP with PSAR Volume IV (HLW) and Volume II (PT), respectively. The BOF activities included auxiliary facilities and systems that do not process radioactive materials but provide support to the process facilities.

4.4.1 BOF Facility Description

The purpose of this review was to determine whether the PSAR adequately described the BOF facility features and processes that could affect safety functions, hazards, or potential accidents (at the completed facility) and their consequences. Examples of facility features are facility location, facility design information, and the location and arrangement of buildings on the facility site. Examples of process features are the general arrangement, function, and operation of major components of the processes for supporting the LAW, HLW, PT and Analytical Laboratory facilities.

As discussed in PSAR Volume V, Sections 2.1 and 2.1.1, the BOF will consist of the facilities and systems listed below. Two of the facilities, the wet chemical storage facility and the glass former facility, will contain process chemicals. Other BOF structures, including the water treatment facility, the steam plant, and the cooling tower facility, will contain chemicals that are involved with water treatment but are not associated with waste processing. The following BOF structures were included in this part of the evaluation:

- Electrical utility distribution systems
- Switchgear building
- BOF switchgear building
- ITS switchgear building
- Administration building
- Chiller/compressor plant
- Water treatment building and storage tanks
- Cooling tower facility
- Fire water pump house and fire water storage tanks
- Nondangerous, nonradioactive liquid effluent facility
- Access control facility
- Simulator facility, located offsite
- Warehouse
- Steam plant
- Wet chemical storage facility

- Diesel generator facility (includes both standby and EDGs)
- Fuel oil facility
- Melter assembly building.

The glass former storage facility will be added to the PSAR list of BOF structures by contractor-approved ABCN 24590-WTP-ABCN-ESH-02-020, *Revision to the BOF PSAR adding facilities/systems to the Construction Authorization Request*, which documented that there were no ITS SSCs in the facility. The reviewers found this determination acceptable

4.4.1.1 Requirements

The elements of the BOF facility and process descriptions were parallel to the review criteria in Sections 3.2.1 and 4.1.1.1 of this SER. The requirements for each are described separately below.

Facility Description – For the BOF facility, the elements included (1) facility location, (2) facility site layout and location of buildings, (3) the facility's ability to resist failures of ITS SSCs, (4) imposed design limits for quantifying the structural behavior of the concrete and steel structures, (5) design and analysis processes used for the ITS structures, (6) ITS electrical systems and components, and (7) ventilation and air cleaning systems and components. Two additional elements included in Sections 3.2.1 and 4.1.1.1 in this SER, protection of control room atmospheres and effluent stacks, are not covered here because the BOF does not have control rooms or effluent stacks.

Process Description – For the BOF facility, the process description elements included (1) a general description of the process, (2) the general arrangement of the major components of the process, (3) a discussion of process design, (4) the operating ranges and limits for process variables, (5) process equipment layout, (6) process design-related codes and standards, (7) instrumentation and controls required for monitoring the process, and (8) process systems for waste management. SRD Safety Criterion 3.1-2 includes requirements for information on process safety. This is addressed as element (9).

4.4.1.2 Evaluation

The results of the evaluation of facility and process descriptions for the BOF are summarized separately below.

Facility Description – The reviewers found that the BOF facility description in PSAR Volume V acceptably met six of the criteria and conditionally met one. The evaluation of the information for each element is summarized below:

1. Information on facility location was discussed in PSAR Section 2.3 and found to be acceptable because the information was adequate to perform the safety evaluation and to define the design basis conditions for the BOF.

2. The reviewers found the layout and location of the buildings for the BOF, as described in PSAR Section 2.1 and Figure 2A-1, to be acceptable and at a level of detail consistent with the preliminary design.

3. The reviewers found acceptable the information on the ability of the BOF's structural design to resist failures of ITS functions; these failures may be caused by credible internal and external events. The following specific evaluations were conducted:

   (a) The reviewers found acceptable the BOF seismic safety classifications and SSCs as detailed in PSAR Table 3-6 because they were consistent with SRD Safety Criterion 4.1-4 and BNI accident analyses.

   (b) The reviewers found acceptable the choices and specific information pertaining to required codes and standards. Most of the BOF SSCs did not provide ITS functions. The BOF ITS SSCs, along with their corresponding seismic classifications, were as follows:

   - ITS switchgear and emergency power distribution (SC-I)
   - ITS switchgear building (SC-II) and basemat (SC-I)
   - ITS UPS (SC-I)
   - ITS power supply cable (SC-I)
   - EDGs and the ITS diesel fuel storage tanks and supporting equipment (SC-I)
   - Concrete pads for EDGs and ITS diesel fuel storage tanks (SC-I)
   - Nitric acid tank and piping (RRC, to be determined)
   - Nitric acid storage tank containment area and the delivery truck bay collection trench/sump (SC-III)
   - Nitric acid monitoring instrumentation (SC-III)
   - EDG separation walls (SC-II)
   - ITS switchgear building HVAC system (SC-II)
   - ITS switchgear building uninterruptible power supply battery exhaust fans (SC-II)
   - ITS electrical ductbank from the ITS switchgear building to the process facilities (SC-II).

The reviewers considered these seismic classifications appropriate and consistent with SRD Safety Criteria 4.1-3 and 4.1-4. The seismic classifications of the non-ITS structures were either SC-III or -IV.

The criteria for other NPHs were the PC-3 criteria for SC-I and -II ITS SSCs and the PC-2 criteria for SC-III ITS SSCs. The reviewers considered this acceptable and consistent with SRD Safety Criteria 4.1-3 and 4.1-4.

4. The reviewers found acceptable the information on imposed design limits for quantifying the structural behavior of the concrete and steel structures. PSAR Table 3-6 identified 19 BOF SSCs that were classified in one of the four established seismic categories, SC-I, -II, -III, and -IV. The reviewers found criteria for each building acceptable as presented in 24590-WTP-DC-ST-01-001. These criteria provided the minimum structural design criteria for each SSC seismic category and ensure that building structures are designed to withstand the effects of design natural phenomena events. Chapter 5 of 24590-WTP-DC-ST-01-001 detailed SC-I and -II building requirements for reinforced concrete, structural steel design, and masonry design. Load factors, load combinations, stability requirements, deflection, anchorage, and story drift requirements were established. Chapter 6 of 24590-WTP-DC-ST-01-001 detailed similar requirements for SC-III and -IV SSCs.

5. The reviewers found acceptable the methods to calculate earthquake loads in 24590-WTP-RPT-ST-01-002, which provided dynamic and static analysis methods for the four categories of buildings and other SSCs required to withstand the effects of earthquakes. The report 24590-WTP-RPT-ST-01-002 addressed the development of design response spectra and associated input time histories, SSI modeling and analysis, and generation of seismic loads and in-structure response spectra. Section 7.2 of 24590-WTP-RPT-ST-01-002 detailed the method of analysis, seismic input motion, dynamic soil properties, SSI foundation modeling, and use of the SASSI computer program for solving SSI problems with embedded flexible foundations. The reviewers found 24590-WTP-RPT-ST-01-002 met the requirements of SRD Safety Criterion 4.1-3 (including DOE-STD-1020-94 and ASCE 4-98). The BOF structural designs and drawings were not complete at the time of PSAR Volume V and therefore were not reviewed.

6. The reviewers found conditionally acceptable the information on preliminary design of the ITS electrical systems and components. The design basis described in PSAR Volume V included the implementing electrical codes and standards identified in SRD Safety Criteria 4.4-2, 4.4-4, and 4.4-9 through 4.4-12. On that basis, the PSAR provided reasonable assurance that the fundamental elements of electrical distribution design will be provided, including features required for adequate functional performance, capacity, loading capability, redundancy, independence, voltage regulation, short circuit capability, electrical protection, controls, system layout, and grounding. PSAR Sections 2.8 and 4.3 addressed ITS electrical systems and components and provided information on electrical components and electrical system design relative to the ITS equipment that it supports. PSAR Figure 2A-2 presented the overall electrical single line diagram for all facilities at the WTP site.

PSAR Sections 2.8.4 and 4.4.4 described the ITS electrical ductbank and its structural design basis. The electrical ductbank would be used for all ITS electrical power service from the BOF to other WTP facilities having ITS loads. Therefore, in addition to the structural standards identified in the PSAR, the configuration of the ITS electrical power circuits contained in the ductbank must satisfy SRD Safety Criterion 4.4-10 and associated implementing electrical standards IEEE Standards 384-1992 and 628-1987, *Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations*. In response to Question BOF-PSAR-007 concerning the lack of discussion or reference to the electrical design basis for the ITS power circuits contained in the ductbank, BNI confirmed that the ITS electrical ductbank would be designed, constructed, and installed according to IEEE Standards 384-1992 and 628-1987; and the electrical design basis would be included in the first PSAR revision. BNI stated that the electrical design basis would include the following features: the ITS ducts would exclusively contain ITS circuits; redundant ITS circuits would be routed in separate ducts and kept separate to ensure that a postulated fault in one ITS circuit or a postulated fire would not damage the redundant ITS circuit; and separation of redundant ITS electrical trains would be maintained according to the requirements of IEEE 384-1992. The reviewers found this commitment acceptable.

The ITS electrical ductbank, as described in PSAR Sections 2.8.4 and 4.4.4, would be the only means for the WTP main control room, located in the PT facility, to control and monitor the BOF ITS functions. Therefore, the configuration of any ITS control and communication circuits contained in the ductbank must also satisfy SRD Safety Criterion 4.4-10 and associated implementing electrical standards IEEE 384-1992 and IEEE 628-1987, *Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations*, as well as Safety Criteria 4.3-1 and 4.3-4 and associated implementing standard ISA S84.01-96, *Application of Safety Instrumentation Systems for the Process Industries*. The reviewers questioned (Question BOF-PSAR-006) why PSAR Sections 2.8.4 and 4.4.4 did not present or reference the design basis for any required ITS control and monitoring circuits contained in the ductbank.

In response, BNI stated that the communication between the BOF ITS SSCs and the PT main control room is through the integrated control network. The integrated control network communication system was tentatively designated an ITS RRC system, and this RRC designation will be revisited through the ISM process using the accepted definition of RRC. In addition, an appropriately dedicated and hardened control and monitoring capability for BOF will also be available in the main control room to ensure that safe state conditions are achieved and monitored. BNI will perform a systematic evaluation of ITS SSCs to identify BOF ITS controls and indications that must be provided in the main control room to ensure that the process facilities can be placed and maintained in a safety state following any DBEs. The appropriate standards with respect to physical integrity, data/signal integrity, independence, and single-failure considerations will be applied. The specific BOF ITS controls and indications provided in the main control room will be identified in the FSAR. BNI committed in the response to clarify the design basis for ITS monitoring and control circuits in the ITS electrical ductbank by including the design

basis information in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

PSAR Sections 2.8.8 and 4.3.5 described the ITS EDG facility. Three independent and redundant EDGs provide emergency power to the ITS SSCs after the loss of the associated primary power system. Each EDG is contained in a separate weatherproof enclosure rated for outdoor use and missile protection. A layout of the facility is shown PSAR Figure 2A-21. The EDGs will start automatically on a loss of normal power. PSAR Appendix A identified and assessed batteries within the EDGs enclosures as potential hydrogen gas explosive hazards. However, these EDGs batteries and associated chargers, auxiliary electrical equipment, and any necessary environmental controls were not described as ITS SSCs in the PSAR. The batteries located within the EDGs enclosures per the hazards assessment were not the batteries and equipment comprising the uninterruptible power, which is located in the ITS switchgear facility and described in Section 4.3.3 of the PSAR.

SRD Safety Criteria 4.4-9 and 4.4-10 for SDC electrical systems and the following associated implementing standards are applicable to the EDGs DC system: IEEE 308-1991; IEEE 338-1987, *Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems*; IEEE 334-1987, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations;* IEEE 379-1994; IEEE 384-1992; IEEE 450-1995; IEEE 484-1996; IEEE 485-1983, *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations*; IEEE 628-1987; IEEE 741-1990, *Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*; IEEE 946-1992, *Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations*; and NFPA 70, "National Electrical Code."

The reviewers questioned (Question BOF-PSAR-008) if there were any batteries in the EDG enclosures. In response, BNI stated the EDGs may be started by battery or compressed air and committed to describe the system in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

7. The reviewers found acceptable the information on ventilation and air cleaning systems as applied to the BOF facility description, discussed in PSAR Section 2.9.14.10. The reviewers found the discussion of the ITS switchgear building HVAC system to be acceptable because it stated that the equipment would be sized to maintain the indoor design conditions within prescribed limits and that the system would have TSR controls associated with its operation. The reviewers found the discussion of the UPS battery room HVAC system to be acceptable because it stated that the HVAC system would be capable of maintaining the batteries within this operating temperature range.

Process Description – The reviewers found seven of the nine criteria for the BOF process description to be acceptable and two to be conditionally acceptable, as found in PSAR Volume V. The review was limited to ITS process SSCs that were part of the BOF. The only BOF SSCs described in PSAR Volume V that directly involved hazardous chemicals (including

use, storage, manufacturing, handling, or onsite movement) were in the wet chemical storage facility. The evaluation of the information for each criteria is summarized below:

1. The reviewers found the general process description to be acceptable. In the overview of the wet chemical storage facility process in PSAR Section 2.9.13, the reviewers found that sufficient information was presented to understand the facility's process.

2. The reviewers found acceptable the discussion of the general arrangement, function, and operation of major components for the wet chemical storage facility, as described in PSAR Section 2.9.13 and Figures 2A-19 and 2A-20. Sufficient information was presented to understand the major components.

3. The reviewers found acceptable the discussion of the process design in PSAR Section 2.9.13 because it discussed the design provisions of the wet chemical storage facility, including receiving and storing resins and reagents, diluting reagents, and monitoring and controlling reagents.

4. The operating ranges and limits considered for the wet chemical storage facility were the compositions and concentrations of the reagents and resins. The molar concentrations and solution concentrations by weight were discussed in PSAR Section 2.9.13. The reviewers found this acceptable because the molar concentrations and weight percentages of the reagents and resins were consistent with the values used in DBE accident analyses for the facility.

5. The reviewers found acceptable the process equipment layout presented in the PSAR because schematic drawings (Figures 2A-19 and 2A-20) showed plan and section views of process equipment.

6. The reviewers found acceptable the process design-related codes and standards, as described in PSAR Section 2.4.3, for the nitric acid storage tank containment area and the delivery truck bay collection trench/sump because they were consistent with SRD Safety Criterion 4.1-4. However, the codes and standards listed in Section 4.3.8.3 for the nitric acid and sodium permanganate monitoring instruments were conditionally acceptable. DBE calculation report 24590-PTF-Z0C-W14T-00030 credited redundancy in the control system to meet the single-failure criterion. SRD Safety Criterion 4.3-2 requires the single-failure criterion be implemented according to a tailored version of IEEE standards, in particular, Standards 379-1994 and 384-1992. PSAR Section 4 did not describe how the design conformed to these standards for the nitric acid and sodium permanganate monitors. The reviewers questioned (Question BOF-PSAR-005) if the single-failure criterion was applied to the nitric acid and sodium permanganate monitor. In response, BNI stated that the criterion would be applied to the control strategy, preventing the nitric acid/resin reaction, consistent with IEEE 379-1994 and 384-1992 in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

7. The reviewers found the instrumentation and controls for monitoring processes and safely shutting down the process to be conditionally acceptable. PSAR Section 4.3.8 discussed

ITS nitric acid and sodium permanganate monitoring instrumentation, which must be able to detect an out-of-specification reagent and prevent transfer from the BOF to the PT facility. The concentrations for nitric acid were consistent with values used in PT DBE analysis.

In the response to Question BOF-PSAR-005 concerning application of the single-failure criterion, BNI stated the sodium permanganate monitor was a remnant of an earlier scoping study and was erroneously left in Volume V of the PSAR. The monitor is not credited in accident analysis in PSAR Volume II (PT); and the hazard analysis results documented in PSAR Volume II, Appendix A, indicate that the event where concentrated sodium permanganate is added to cesium ion exchange resin is incredible due to dilution in the path through vessels required for the event. BNI also stated in its response that the sodium permanganate monitor would be removed as an ITS SSC in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

8. PSAR Volume V did not discuss the wet chemical storage facility practices to minimize the production of chemical wastes. However, the facility's function is to provide reagents to the PT, LAW, and HLW facilities and store new ion exchange resins; minimal production of chemical wastes would occur. The reviewers found this acceptable.

9. The reviewers found acceptable the information provided on hazardous materials, including toxicity, permissible exposure limits, physical data, reactivity data, corrosivity data, thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials. The various chemical hazards were provided in 24590-WTP-RPT-ESH-01-001 and in Material Safety Data Sheets. PSAR Tables 3-1, 3-3, and 3-7 summarized the process chemicals used in the BOF facility, their volumes, and their use rates. Tables 3-2 and 3-8 provided a matrix of possible interaction of the chemicals in the water treatment facility and the wet chemical storage facility, respectively. In addition, PSAR Appendix A included chemical hazard situations that were evaluated in the DBEs. The reviewers concluded the PSAR contained adequate information at this stage of the design on safe upper and lower limits for parameters controlled for safety reasons, such as tank volumes, temperatures, and molar weights. These values listed in PSAR Section 3.4 were consistent with the values used in the DBE analyses for the wet chemical storage facility. The reviewers concluded that the process description contained sufficient information on process safety as required by SRD Criterion 3.1-2.

4.4.1.3 Conclusions

The conclusions for the facility and process descriptions are presented separately below.

Facility Description – The reviewers concluded that the information in PSAR Volume V of the PSAR was conditionally acceptable for the facility description as detailed in RL/REG-99-05. The facility description was adequate to support the hazard and accident analysis for the BOF.

Conditions of Acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. As discussed in Section 4.4.1.2, Facility Description, Item 6:

   (a) Provide the electrical design basis for the ITS electrical ductbank, as committed to in response to Question BOF-PSAR-007.

   (b) Clarify the design basis for ITS monitoring and control circuits in the ITS electrical ductbank, as committed to in response to Question BOF-PSAR-006.

   (c) Provide a description of the system for starting EDGs, as committed to in response to Question BOF-PSAR-008.

Process Description – The reviewers found the information provided by Volume V of the PSAR conditionally acceptable for process description detailed in RL/REG-99-05.

Conditions of Acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. Describe application of the single-failure criterion to the nitric acid monitor, as committed to in response to Question BOF-PSAR-005. (See Section 4.4.1.2, Process Description, Item 6.)

2. Delete the ITS sodium permanganate monitor, as committed to in response to Question BOF-PSAR-005. (See Section 4.4.1.2, Process Description, Item 7.)

4.4.2 BOF Hazard and Accident Analysis

The purpose of this review was to determine whether the PSAR adequately described the hazard and safety analyses performed for the BOF. The review also determined whether the analyses complied with the SRD and ISMP and would ensure adequate safety of the BOF design to protect the health and safety of the workers, the public, and the environment.

4.4.2.1 Requirements

SRD Volume II, Appendix A, Section 4.0, "Hazard Evaluation," requires evaluation of the following nine elements of hazard and accident analyses: (1) identifying hazards, (2) identifying potential accident/event sequences, (3) estimating accident consequences, (4) estimating accident frequencies, (5) considering common-cause and common-mode failures, (6) defining DBEs, (7) defining the operating environment, (8) identifying potential control strategies, and (9) documenting the hazard and accident evaluation. In addition, the identification of assumptions and analysis of uncertainty should be evaluated. Additional SRD safety criteria provided requirements for hazard and accident analysis: 2.0-2 for identifying dose hazards, 3.1-1

for identifying hazards, 3.2-1 for identifying potential accident/event sequences, and 3.1-3 for estimating accident consequences.

For internal DBEs, the evaluation should assess the identification and analysis of internal DBEs that are affected by the BOF design. For external DBEs, the evaluation should assess selection of the seismic and other external events, such as wind, flood, missiles, snow, and volcanic ash. Facility preliminary seismic analyses should be evaluated to ensure that the preliminary BOF design would meet applicable requirements for load when subjected to the design-basis earthquake. Consistent with the preliminary design, the evaluation should assess the chemical process safety of the design and whether the PSAR adequately identified and analyzed potential chemical hazards and accidents associated with the BOF.

4.4.2.2 Evaluation

The reviewers evaluated information provided in PSAR Volume V, Sections 3 and 4 and Appendix A; and in report 24590-BOF-RPT-ESH-01-001, *Design Basis Event Selection for Balance of Facility Preliminary Safety Analysis Report*. Relevant references in PSAR Volume V were also reviewed to determine the information's completeness and accuracy in supporting the conclusions and to determine the implementation and documentation of the ISM process as it applied to the BOF hazards and accident analysis results. These references included calculations, studies, drawings, system notebooks, detailed information from SIPD, system description reports, and other relevant supporting documentation. The reviewers found five of the nine elements to be acceptable, two to be conditionally acceptable, and one not applicable. The evaluation of the information for each element is summarized below:

1. **Identifying Hazards** – The reviewers found the identification of hazards to be conditionally acceptable. The hazards were described in PSAR Volume V, Section 3.3, and Appendix A CSD records; and the hazards analysis results were described in 24590-BOF-RPT-ESH-01-001. The PSAR identified hazards that included external events, such as seismic, ashfall, wind and snow; internal events such as fire, chemical hazards; and human error, such as vehicle impact, tank collapse from a vacuum, load drop from a portable crane, delivery of chemicals to the wrong tank, or a drain valve left open. The reviewers also evaluated hazards from airplane crashes on BOF structures.

   BNI's evaluation of hazardous chemicals at the WTP, including the BOF, is documented in 24590-WTP-RPT-ESH-01-001. This evaluation stated that 12.2 Molar (M) nitric acid is the only chemical in the BOF that could cause death or serious injury because of its acute toxic effect. As stated in 24590-WTP-RPT-ESH-01-001, nitric acid is received at a 12.2 M concentration for dilution to 5 M, 2 M, and 0.5 M concentrations at the wet chemical storage facility. The dilution and distribution process is automated and controlled by the distributed control system. The 12.2 M nitric acid storage tank receives nitric acid unloaded from a tank truck via the truck unloading pump. The amount of 12.2 M nitric acid in the wet chemical storage facility is estimated to be 17,000 ft^3.

   The hazard evaluation for the wet chemical storage facility resulted in two DBEs: a nitric acid spill and a nitric acid or sodium nitrite mis-transfer resulting in the mixing of these

two chemicals and release of NO_x. The reviewers concluded that this hazard identification was acceptable.

These hazard evaluations also concluded that the BOF has no radiological hazards. However, events in other facilities have radiological consequences and rely on controls located in the BOF for prevention or mitigation. These controls include providing emergency electrical power to the PT and HLW facilities and preventing high concentration acid from being transferred to the PT facility and reacting with the IX column resin. The hazard and accident analysis for events requiring these controls are documented in PSAR Volumes II and IV (PT and HLW, respectively).

Because the BOF contained no radiological source terms, these facilities were preliminarily categorized as Hazard Category 3 using DOE-STD-1027-92. The reviewers agreed with this categorization.

Similar to PSAR Volumes III and IV (LAW and HLW, respectively), the reviewers identified discrepancies concerning the CSD record identification numbers within the PSAR and between the PSAR, associated calculations, and drawings. The hazard identification number for the same hazard did not always match between the documents. The reviewers questioned (Question BOF-PSAR-010) why CSD records for the same hazardous situation had different identification numbers in different documents. In response, BNI committed to correct the CSD and safety case requirement identification numbers in the affected documents in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

PSAR Volume V did not address hazards associated with the failure of nonseismically qualified structures and components that could impact seismically qualified structures and components. This is commonly known as seismic 2/1 interaction. SRD Safety Criterion 4.1-3 requires, in part, that SSCs which are designed SDS (except those so designated based solely on chemical hazards) whose continued function is not required for an NPH event, but whose failure as a result of an NPH event could reduce the functioning of an SDC SSC such that exposure standards might be exceeded, shall be designed to withstand the NPH loading. In response to Question BOF-PSAR-016 concerning the analysis addressing seismic-related 2/1 type hazards for the BOF, BNI stated that no rigorous seismic 2/1 analysis had been performed because the level of detail for the BOF was not adequate to perform such an analysis. BNI further stated that this analysis would be performed as part of ISM Cycle III when design detail becomes available, and the results will be factored into the final design. This explanation was acceptable to the reviewers.

A seismic event could result in fire protection piping and/or component failure, causing water spray in areas above ITS electrical components and degraded operation of all ITS electrical trains. The reviewers questioned (Question BOF-PSAR-015) whether the design of ITS electrical equipment would protect against failure of nonseismically qualified fire protection piping and components. In response, BNI committed that the design will accommodate the accidental water spray and stated that this design detail would be provided in the FSAR. This commitment was acceptable to the reviewers.

For hazards from airplane crashes, calculation report 24590-WTP-Z0C-50-00001, Revision B, was reviewed. This calculation report evaluated the effect on the public from the postulated release of chemicals caused by an airplane crashing into the wet chemical storage facility and concluded that the release was less than the limits specified in SRD Safety Criterion 2.0-2, which are ERPG-2 limits to the public. This calculation report also documented that the vulnerability of the ITS switchgear and the ITS EDG buildings to airplane crashes was $<10^{-6}$ / year. Reviewers found this hazard identification acceptable.

The PSAR evaluated structural loading of ash in an ashfall event; however, it did not fully evaluate the effect of ash in the air when ITS components and systems are required to operate. Some ITS components, such as EDG combustion air and cooling units, were discussed in PSAR Volume V, Appendix A, as being designed for an ashfall event, but others were not. Those not discussed included EDG electric generator forced air cooling system and bearings, starting air (if applicable), fuel oil tank vents, and transmission line insulators. The reviewers questioned (Question PT-PSAR-257) how the impact of an ashfall was evaluated. In response to this question, which refers to the response to PT-PSAR-204, BNI committed to analyze the potential effects of a design basis ashfall event and provide controls in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment to be acceptable because the analysis performed in the PSAR was appropriate for the preliminary design detail.

2. **Identifying Potential Accident/Event Sequences** – The reviewers found the identification of potential accident/event sequences to be acceptable, as described in PSAR Volume V, Chapter 3 and Appendix A CSD records; and in 24590-BOF-RPT-ESH-01-001. The reviewers found that Chapter 3 and Appendix A, along with the BOF DBE calculations, provided (a) accident sequences that identified initiating events with their prevention and mitigation measures and other contributing phenomena, (b) the rationale for sorting hazardous situations into accident groups or categories, and (c) selection of accident sequences that was comprehensive and credible.

PSAR Volume V, Sections 3.3.1, 3.3.2, and 3.3.3 and Appendix A, identified internally and externally generated initiating events in the BOF, including the ITS switchgear, ITS portions of the diesel generator facility, and the wet chemical storage facility. This identification included event sequences associated with chemical hazards, including the presence of 12.2 M nitric acid and its interactions with other chemicals. The hazard evaluation identified potential accident sequences for the wet chemical storage facility that resulted in two DBEs associated with 12.2 M nitric acid. Additionally, failures of ITS portions of the diesel generator facility and ITS switchgear can lead to radiological releases in the process facilities and are addressed in PSAR Volumes II and IV. The information satisfied the requirements in SRD Safety Criterion 3.2-1; the SRD, Appendix A, Section 4.2, "Identification of Potential Accident/Event Sequences"; and the ISMP, Section 1.3.6, "Accident Analysis."

Another chemically related event sequence impacting the PT facility was the transfer of high concentration nitric acid to the PT facility from the wet chemical storage facility in the BOF, causing reactions with the IX column resins. PSAR Volume V, Section 3.4.1.7,

identified the event sequences associated with high nitric acid-resins reaction events, which can yield unmitigated SL-1 consequences.

3. **Estimating Accident Consequences** – The reviewers found the estimation of accident consequences to be acceptable, as described in PSAR Volume V, Chapter 3 and Appendix A CSD records, and in 24590-BOF-RPT-ESH-01-001. PSAR Section 3.4.1 provided the results of unmitigated and mitigated consequence analysis for the potential accident/event sequences for the BOF. The reviewers found these results satisfied the requirements of SRD Safety Criteria 3.1-3 and 3.1-4, and the SRD, Appendix A, Section 4.3, "Estimation of Consequences." The results are discussed below:

(a) **Unmitigated Consequences** – Reviewers found the estimates of unmitigated chemical consequences acceptable because they satisfied Appendix A of the SRD for determining unmitigated consequences. For the BOF hazardous situations, PSAR Appendix A identified the radiological consequences above SL-4 and chemical consequences above threshold. The hazardous situations included those within the BOF and PT and HLW process facilities relying on ITS functions performed by the BOF. Those functions are the delivery of emergency power and transfer of process chemicals.

(b) **Mitigated Accident Consequences** – Reviewers found the estimates of mitigated consequences for the two DBEs acceptable because they satisfied the requirements of Safety Criterion 2.0-2 and Appendix A of the SRD for determining mitigated consequences.

PSAR Sections 3.4.1.1 and 3.4.1.2 estimated the mitigated chemical releases from a 12.2 M nitric acid spill event and the nitric acid or sodium nitrite mis-transfer event resulting in the mixing of these two chemicals. The mitigated chemical releases from a 12.2 M nitric acid spill event for the public and co-located worker were found to be below the SRD Safety Criterion 2.0-2 public exposure standard (ERPG-2) and co-located worker exposure standard[142] (ERPG-3) for nitric acid. For the facility worker, the mitigated nitric acid concentration at the facility worker location was above the SRD Safety Criterion 2.0-2 exposure standard. Operator response (evacuation), along with the ITS SDC nitric acid storage tank containment area and the delivery truck bay collection trench/sump, was credited for keeping the exposure to acceptable levels.

The mitigated releases from the nitric acid or sodium nitrite mis-transfer event for the public and co-located worker were found to be below the SRD Safety Criterion 2.0-2 public and co-located worker exposure standards (temporary emergency exposure limits 2 and 3, respectively) for both NO and NO_2. SRD Safety Criterion 2.0-2 states that temporary emergency exposure limits may be used as a substitute for ERPGs where ERPG values have not been published. For the facility worker, the mitigated NO and NO_2 concentrations at the facility

[142] The exposure standard is the level required to cause in-patient hospitalization of at least 3 facility workers or at least a single fatality (assumed by BNI to be the immediately-dangerous-to-life-or-health value).

worker location were above the immediately-dangerous-to-life-or-health value. The selected controls included evacuation, physically separate unloading stations for each chemical, labeling of reagent lines, and dedicated facility operators to oversee reagent unloading. The reviewers considered these controls acceptable for this chemical release event.

4. **Estimating Accident Frequencies** – PSAR Volume V did not determine estimates for accident frequency for the BOF chemical exposure DBEs because Safety Criterion 2.0-2 does not require such estimates for toxic chemical hazards. Accident frequencies for the PT and HLW facilities that rely on ITS SSCs located in the BOF were addressed in PSAR Volumes II and IV. Therefore, this criterion was not applicable to the BOF review.

5. **Considering Common-Cause and Common-Mode Failures** – The reviewers found acceptable the consideration of common-cause and common-mode failures as described in PSAR Volume V, Section 3.3.4 and Appendix A CSD records; in 24590-BOF-RPT-ESH-01-001; and in referenced DBE calculations. The reviewers found the information on common-cause/common-mode failures to be acceptable because it satisfied the requirements of the SRD, Appendix A, Section 4.5, "Consideration of Common Cause/Common Mode Failures," and SRD Safety Criterion 4.3-3.

   As stated in PSAR Section 3.3.4, failures in the BOF services have the potential to become common-cause initiators for accidents in more than one of the process facilities because the BOF services support the process buildings and safety functions. For example, if a failure as a result of a common-cause event were to occur in the ITS switchgear building, it could prevent power from being delivered to the ITS equipment in PT and HLW. This would create a common-cause operability condition in HLW and PT process facilities. Credible common-cause events that could affect the ITS switchgear building, the ITS portion of the diesel generator facility, and the ITS portions of the wet chemical storage facility included natural phenomena events, such as seismic events, volcanic ashfall, external man-made events, fire, internal missiles, internal spray from fire protection piping, and flooding.

   PSAR Appendix A documented the hazards associated with the potential for human error and external events, including NPH events, that could initiate credible common-mode failures. Appendix A also considered and identified credible common-mode failures from failures of dependent subsystems (functional dependencies) and from failures of SSCs whose functional capabilities are required for the systems through dependent failure modeling.

   For external events, including NPH events, the safety case requirements for these hazards identify that these impacts are prevented because appropriate design criteria and features are used. These design criteria and features include using redundant SC-I ITS switchgear trains located in an SC-II building with appropriate fire barriers (which also function as missile shields) and redundant HVAC systems for environmental control and hydrogen removal (from batteries). Also, three independent and redundant EDGs are qualified to operate in the analyzed NPHs, including seismic, wind-generated missiles, missiles

generated from failure of standby diesel generators, and ashfall. ITS separation walls are provided between EDGs to provide thermal shielding from adjacent fires.

For human error, vehicle impact barriers are located near nitric acid tanks to prevent collision with the tank, and unique connections with dedicated piping are located to prevent inadvertent delivery of nitric acid to caustic tanks, or vice versa. To prevent spills due to overfill of nitric acid tanks, there is a high-level feed trip. Also, liquid release from a nitric acid tank would be confined to a limited area provided by engineered berms. The reviewers found the consideration of common-cause and common-mode failures using functional and spatial dependency analysis to be acceptable.

6. **Defining DBEs** – The reviewers evaluated both internal and external DBEs in the BOF PSAR and found them acceptable. PSAR Volume V considered, described, and analyzed the internally initiated and externally initiated DBEs that could affect safety, including seismic events, wind, flooding, volcanic ash, and snow. The preliminary design adequately addressed the impacts of these DBEs on the BOF, including the BOF ITS SSCs, from these internal and external events.

   (a) **Internal DBEs** – The reviewers found acceptable BNI's selection of internal DBEs, where the selected DBEs defined the bounding hazard control strategies for the BOF. Based on the DBE selection analysis in PSAR Volume V, Sections 3.3 and 3.4 and Appendix A, and in 24590-BOF-RPT-ESH-01-001, BNI concluded that only two internal DBEs could produce chemical releases in excess of SRD limits: a 12.2 M nitric acid spill event and the nitric acid or sodium nitrite mis-transfer event at the wet chemical storage facility. The selection of DBEs for the BOF was performed according to the design guide for ISM (24590-WTP-GPG-SANA-002), which conformed with SRD Appendix A requirements for accident analysis. DBEs were selected from the SIPD provided in PSAR Volume V, Appendix A. Based on review of SIPD for the BOF, the reviewers agreed that the selection of two DBEs was appropriate.

   For the 12.2 M nitric acid spill DBE at the wet chemical storage facility, PSAR Section 3.4.1.1 identified CSD-BNAR/N0001, structural failure of the tank, as the representative event. Nitric acid releases in the wet chemical storage facility were bounded by a spill from the 12.2 M nitric acid storage tank. This tank contained the most concentrated acid in the BOF. The total inventory of the nitric acid tank was assumed to spill. The wet chemical storage facility is covered but open on both sides, so the nitric acid vapor would release directly to the atmosphere.

   Also, for the nitric acid or sodium nitrite mis-transfer event at the wet chemical storage facility, PSAR Section 3.4.1.2 identified CSD-BNAR/N0009, inadvertent delivery of nitric acid to sodium nitrite tank, or vice versa, as a DBE; and Section 3.4.1.2.1 evaluated the consequences from a mis-transfer involving 12.2 M nitric acid and a 5.9 M sodium nitrite solution. Calculation report 24590-BOF-ESH-01-001 stated that this mis-transfer can only occur from the human error of offloading the tanker truck to the wrong storage tank. The mixture of

these two chemicals results in a nitrous acid solution, which decomposes into the toxic gases NO and NO_2.

(b) **External DBEs** – The reviewers found acceptable the selection and analysis of external DBEs that affect the BOF. Appendix A of the SRD requires design basis natural phenomena to be as defined in SRD Safety Criteria 4.1-3 and 4.1-4. The reviewers evaluated information presented in PSAR Volume V, Chapters 2 and 3 and Appendix A, and responses to questions concerning design and analysis for external facility natural phenomena events. The external events included seismic, snow and volcanic ash loads, volcanic ash effects on equipment operability, wind loads, wind-generated missiles, other internal missiles, and flooding.

PSAR Volume V, Section 3.4.2, stated that no external DBEs were selected for the BOF. The PSAR stated that the consequences and required controls for external events affecting chemicals are the same as for internal events. The PSAR identified performance categories for ITS SSCs and associated NPH design requirements consistent with SRD Safety Criteria 4.1-3 and 4.1-4. The reviewers agreed that unique external DBEs (other than the seismic DBEs) did not need to be defined for the wet chemical storage facility because the internal DBEs already included the most limiting event, a total spill of the nitric acid inventory.

The reviewers found the PSAR to be acceptable for the eight information areas identified in RL/REG-99-05, Section 4.6.3.3.1, for seismic events and six information areas for other NPH. PSAR Volume V, Table 3-6, identified nineteen BOF SSCs classified into one of the four established seismic categories, SC-I, SC-II, SC-III and SC-IV.

In reviewing structural calculation reports as part of the PSAR review for the WTP, reviewers found that BNI uses design guides in the WTP design. Report 24590-WTP-DC-ST-01-001, developed for WTP facilities, provides the minimum structural design criteria for each seismic category building and SSC. These criteria ensure that building structures are designed to withstand the effects of natural phenomena events postulated to occur during the life of the building. These criteria also describe the natural phenomena events selected as the bases for the design and evaluations of ITS SSCs and provide the rationale for their selection. Chapter 5 of the criteria details the SC-I and -II building requirements for reinforced concrete, structural steel design, and masonry design. The applicable load factors, load combinations, stability requirements, deflection, anchorage, and story drift requirements are also established. Chapter 6 of the criteria details similar requirements SC-III and -IV SSCs.

The structural design criteria referenced 24590-WTP-RPT-ST-01-002 as the method used to calculate earthquake loads. This analysis criterion provided dynamic and static analysis methods for SSCs required to withstand the effects of earthquakes without significant damage or loss of safety function. The analysis criteria address development of design response spectra and associated input time histories, SSI modeling and analysis and generation of seismic loads, and in-

structure response spectra. Section 7.2 of 24590-WTP-RPT-ST-01-002 detailed the method of analysis, seismic input motion, dynamic soil properties, SSI foundation modeling, and use of the SASSI computer program for solving SSI problems with embedded flexible foundations. Report 24590-WTP-RPT-ST-01-002 met the seismic requirements of SRD Safety Criteria 4.1-3 and 4.1-4, including DOE-STD-1020-94 and ASCE 4-98 requirements; and the reviewers found the methodology acceptable.

The reviewers evaluated these commitments for the BOF structures that contain ITS SSCs, including the ITS switchgear facility, diesel generator facility, and the wet chemical storage facility. The reviewers found that the appropriate commitments to address normal, off-normal, and accident loads (seismic and other NPH loads) were applied to these facility structures and were, therefore, acceptable. Evaluation of the information for the seismic forces for each of the eight information areas is summarized below. These commitments addressed the following:

(i) Basemat, walls, roofs and interfacing structures for the ITS SSCs in the BOF

(ii) Appropriate seismic hazard curve and response spectra for the BOF containing ITS SSCs

(iii) Appropriate seismic analysis methods for calculations and appropriate requirements for treating torsional effects and determining structure overturning moments and design margins

(iv) Appropriate seismic analysis methods and specifications, including models, methods, element seismic demands, factored and combined total element structural demands and comparison to reinforced concrete element structural capacities, rebar design details, design margins for structural design adequacy and appropriate interpretation of acceptance criteria, and the process to compare the calculated seismic and total demands with the corresponding capacities

(v) Appropriate methods for anchoring the reinforcement bars in the reinforced concrete design and appropriate requirements for anchoring major components by embedments in structures

(vi) Appropriate methods for considering beyond-design-basis earthquake seismic events

(vii) Appropriate methods for calculations and design criteria for other external event forces as applied to the structural analysis and design of ITS SSCs in the BOF for the effects of design-basis winds, volcanic ash, and snow as it relates to the design of ITS SSCs in the BOF

(viii) Appropriate methods for defining safety functions and the operability of each feature as required for seismic safety for ITS SSCs in the BOF.

For other external NPH forces, the reviewers evaluated design information in PSAR Volume I, *General Information*, and Volume V and the response to Question PT-PSAR-257 concerning the design and analysis for other external facility phenomena and events (e.g., snow, volcanic ash, wind, missiles due to wind, and flooding) for the BOF that contain ITS SSCs. The reviewers found the commitments resulted in the six information areas identified in RL/REG-99-05, Section 4.6.3.3.2, being acceptably met. These commitments addressed the appropriate methods for the following:

(i) Wind loads

(ii) Missiles due to wind

(iii) External flooding

(iv) Roof loads due to volcanic ash and snow loads

(v) Evaluation of the accidental aircraft crashes, where results for the BOF that contain ITS SSCs were discussed previously

(vi) Analysis and software used in calculations.

7. **Defining the Operating Environment** – The reviewers found the definition of operating environments and performance requirements to be acceptable. The PSAR identified a set of bounding operating conditions and performance requirements for the ITS SSCs in the BOF according to requirements in the SRD, Appendix A, Section 4.7, "Definition of Operating Environment." The bounding operating environmental requirements considered temperature, pressure, humidity, radiation levels, and chemical environmental requirements.

8. **Identifying Potential Control Strategies** – The reviewers found conditionally acceptable the identification of potential control strategies and documentation of required information for each ITS SSC. Information on potential control strategies was provided in PSAR Volume V, Sections 3.3, 3.4, 4.3, and 4.4, and Appendix A, including control strategy elements and safety case requirements identified in the CSD records; and in DBE calculations 24590-BOF-Z0C-00001, *Design Basis Event: Balance of Facilities 12.2M HNO_3 Vessel*, and 24590-BOF-Z0C-00002, *Design Basis Event: Balance of Facilities HNO_3-$NaNO_2$ Mis-transfer*. This information identified the potential control strategies associated with hazards, accidents, and DBEs. Additionally, control strategies or design requirements were identified to address the capability of the BOF ITS SSCs that support the ITS SSCs in the HLW and PT in performing their ITS functions.

PSAR Volume V, Chapter 4, provided information for each ITS SSC using the format defined in Section 4.5.3.3.3 of RL/REG-99-05. BNI identified ITS SDC, SDS, and RRC

SSCs, along with their safety functions, in PSAR Volume V, Tables 4-1 (SDC), 4-2 (SDS) and 3-5 (RRC). The reviewer found the identification of the SDC and SDS SSCs and their safety functions to be acceptable. Reviewers found discrepancies in identification of RRC SSCs as described in Section 4.3.3.2, Item 1, of this SER. BNI committed to correct these discrepancies in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable because the RRC SSCs were, by definition, of lesser safety significance than the SDC and SDS SSCs addressed by the hazards and accident analysis results documented in the PSAR and would not be expected to result in significant changes to the facility design or safety conclusions.

9. **Documenting the Hazard Evaluation** – The reviewers found the documentation of the hazards evaluation and accident analysis to be conditionally acceptable, as presented in PSAR Volume V, Chapter 3 and Appendix A CSD records; and in 24590-WTP-RPT-ESH-01-001. The condition of acceptance involves inconsistencies in CSD and safety case requirement identification numbers and is discussed in Section 4.4.2.2, Item 1, of this SER.

   Uncertainties in models (e.g., input assumptions, boundary conditions, and modeling techniques), data, and phenomenology used in estimating accident consequences and frequencies were described in the calculations for DBEs. In the analysis of the DBEs, these calculations also identified other uncertainties and assumptions important to the calculation results. The reviewers evaluated these descriptions in the DBE calculations and found them to be acceptable.

4.4.2.3 Conclusions

The reviewers concluded that the results of hazard and accident analysis for the BOF were conditionally acceptable. The hazards information, as supplemented by information in responses to the reviewer questions and in referenced calculations, was consistent with the preliminary design. The radiological, chemical, and process hazards associated with operating the BOF, including hazards from postulated accidents and failures to provide ITS support to HLW and PT ITS SSCs, were adequately assessed and sufficient control or mitigation features were identified. PSAR Volume V, along with its referenced calculations and documentation in the formal responses to reviewer questions, adequately documented the safety basis for constructing the BOF.

Conditions of Acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. Correct CSD and safety case requirement identification numbers in the PSAR and referenced documents, as committed to in response to Question BOF-PSAR-010. (See Section 4.4.2.2, Item 1.)

2. Analyze the potential effects of a design basis ashfall event and provide controls, as committed to in response to Question PT-PSAR-204. (See Section 4.4.2.2, Item 1.)

4.4.3 BOF Important-to-Safety SSCs

The purpose of this review was to determine whether the PSAR adequately identified ITS SSCs and the most severe anticipated conditions under which they must function to support construction authorization of the BOF.

4.4.3.1 Requirements

The reviewers evaluated whether BNI adequately determined and documented for each ITS SSC in the BOF the six elements described in Section 3.4.1[143] of this SER: (1) SSC identification, (2) safety function, (3) system description, (4) functional requirements, (5) system evaluation, and (6) controls (TSRs). Additional guidance was provided in RL/REG-99-05, Section 4.5.3, "Defining Operating Environments and Performance Requirements."

4.4.3.2 Evaluation

The reviewers found the description of BOF facility ITS SSCs to be conditionally acceptable. BNI's methods and selection criteria for ITS SSCs were discussed in PSAR Volume I, Section 4, and the reviewers' evaluation documented in Section 3.4 of this SER. PSAR Volume V, Section 4, identified eight SDC and five SDS ITS SSCs in the BOF that were required to provide the necessary preventive or mitigative functions in the accident analysis to meet the radiation exposure standards defined in SRD Safety Criterion 2.0-1 and the chemical exposure standards defined in SRD Safety Criterion 2.0-2. Additionally, RRC SSCs were identified for the BOF; RRC SSCs were defined as all ITS SSCs that were neither SDC nor SDS.

PSAR Volume V, Section 4.3, identified specific ITS SSCs designated as SDC and their respective safety functions. Specific ITS SSCs designated as SDS and their respective safety functions were identified in PSAR Volume V, Section 4.4; and Table 3-5 lists the RRC systems and their safety functions.

1. **SSC Identification** – PSAR Chapter 4 identified BOF systems that support SDC and SDS functions in the WTP process facilities. These ITS SSCs are listed in Section 4.4.1.2, Item 3, of this SER. Some of these ITS SSCs support accident mitigation in the HLW and PT facilities. Based on a review of the DBEs and their control strategies in BOF, HLW and PT, reviewers concluded that the identification of these systems as ITS was acceptable.

   SSCs designated RRC were not identified in Chapter 4 but in Table 3-5 of the BOF submittal. Reviewers questioned (Question BOF-PSAR-016) what analysis had been performed and documented to address 2/1 type hazards. In addition to answering this question, BNI identified discrepancies in PSAR Table 3-5 when comparing RRC functions with the BOF between corresponding PT and HLW RRC Tables. In particular, Table 3-5 incorrectly identified the PT vessel cooling system, whereas the PT PSAR

[143] RL/REG-99-05, Section 4.5.3.3.3, "Regulatory Acceptance Criteria."

identified the process cooling water system. Similarly, the HLW RRC table had two discrepancies when compared with the BOF RRC Table 3-5. The HLW melter enclosure protection and the HLW air purge into standby offgas system were included in BOF Table 3-5 but not in the corresponding HLW RRC table. In response to Question BOF-PSAR-016, BNI committed to correct these discrepancies in RRC identification in the first PSAR revision following authorization for full facility construction. The reviewers found this commitment acceptable.

2. **Safety Function** – The reviewers found acceptable the identification of the safety functions discussed for each ITS SSC listed in PSAR Chapter 4. The safety functions expressed the SSCs objective in the given accident scenario. Specific accident(s) associated with the safety functions were identified.

3. **System Description** – The reviewers found the description of the ITS SSCs in PSAR Volume V, Section 4.3.1, to be acceptable. Chapter 4 included a section that described the SSC. The reviewers determined that system descriptions of the RRC SSCs were not provided in Table 3-5 of Volume V of PSAR. However, this was acceptable because the RRC SSCs had defined safety functions and performance requirements and standards will be defined later according to Appendix A of the SRD.

4. **Functional Requirements** – The reviewers found the description of the functional requirements of the ITS SSCs discussed in PSAR Chapter 4 to be acceptable.

5. **System Evaluation** – The reviewers found the system evaluation for the ITS SSCs as described in PSAR Volume V, Chapter 4, to be acceptable. For each SDC and SDS SSC identified, the chapter included a section that evaluated the functional requirements versus the proposed design information for the SSC and integrated safety systems. The reviewers found the evaluations to be complete and adequate.

6. **Controls (TSRs)** – The reviewers found acceptable the ITS SSC control requirements described in PSAR Volume V, Chapter 4. These controls were compared with the draft TSR derivations in PSAR Volume V, Section 5.5, to ensure that the identified SSCs in Chapter 4 were adequately addressed in Chapter 5. No discrepancies were noted in the comparison.

4.4.3.3 Conclusions

The reviewers concluded that the identification, description, and documentation of BOF SDC and SDS ITS SSCs in the PSAR were conditionally acceptable. Similar information was not required for RRC SSCs. RRC SSCs were acceptably identified and their safety functions were defined. The reviewers concluded this was acceptable and consistent with the approved SRD.

Conditions of Acceptance – BNI must complete the following action in the first PSAR revision following authorization for full facility construction:

1. Correct RRC SSC identification errors between Volumes II, IV, and V of the PSAR, as committed to in response to Question BOF-PSAR-016. (See Section 4.4.3.2, Item 1.)

4.4.4 BOF Technical Safety Requirements

The purpose of this review was to determine whether the PSAR adequately the draft TSRs for the BOF.

4.4.4.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," and SRD Safety Criterion 9.2-2 contain the requirements for the draft TSRs.

4.4.4.2 Evaluation

The reviewers found the draft TSRs to be acceptable. In PSAR Volume V, the draft TSRs provided information commensurate with the preliminary stage of the facility design. These draft TSRs included limiting conditions of operation, associated surveillance requirements (mostly to be determined), administrative controls, bases (also mostly to be determined), and design features. No safety limits were identified and are not expected to be needed to implement adequate control strategies for the facility. PSAR Volume I, Section 5.5.6.1, states, in part, "No safety limits are envisioned for the WTP, but they will be provided if warranted by the safety analysis."

The review of the draft TSRs was limited to consistency checks to ensure that safety functions derived in PSAR Volume V, Chapter 4, were carried forward to form the basis for deriving the TSRs in PSAR Volume V, Chapter 5.0, and to ensure consistency between the TSR derivation in Chapter 5.0 and the draft TSRs. Limiting conditions of operation and surveillance requirements were identified to protect the active safety functions of ITS SSCs; design features were identified to protect passive safety functions by maintaining the configurations assumed in the hazard and accident analyses; and administrative controls were defined to describe safety management programs. Detailed review leading to approval of TSRs will be performed along with the review of the FSAR before facility operation is authorized. The draft TSRs described in PSAR Volume V, Chapter 5, were verified to be consistent with the hazard and accident analyses information in Chapter 3 and the safety basis SSCs in Chapter 4.

The reviewers found the draft TSRs consistent with the requirements of RL/REG-99-05, Section 4.8. Additionally, in PSAR Volume V, Section 5.2, BNI committed to use DOE G-423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*, as tailored in the SRD, Appendix C, "Implementing Standards," as an implementing standard for TSRs.

4.4.4.2 Conclusions

The reviewers concluded that the draft TSRs for the BOF were acceptable.

4.5 Analytical Laboratory

Review of the Analytical Laboratory is not part of this SER. Information on the Analytical Laboratory will be submitted with the Analytical Laboratory PSAR. The submittal schedule is currently being developed.

4.6 Safety Basis/Conformance with Facility Risk Goals

Per the SRD, BNI is required to follow an overall approach to safety that integrates the radiation dose standards for normal operations and effluents, accidents, ALARA design objectives, and risk goals for operating the facility with mandatory defense-in-depth principles. Conformance with the facility risk goals was evaluated according to SRD Safety Criteria 1.0-3, 1.0-4, 1.0-5, and 2.0-1 and RL/REG-2000-08, as discussed below with respect to the LAW, HLW, and PT facilities. The impact, if any, of the Analytical Laboratory will be addressed in future revisions of this SER.

4.6.1 Requirements

WTP regulatory documents refer to "risk" in various locations.[144] For example, Section 2.0 of RL/REG-2000-08 states, "Acceptable risk analyses should be applied during the design to delineate provisions for the prevention and mitigation, including emergency preparedness and response, of otherwise risk-dominant events." The definition of "important to safety" in the SRD also requires that the top-level safety standards and principles be applied to SSCs "commensurate with their contribution to risk."

Three "risk goals" are provided to limit the risk of fatality to a selected population (SRD Safety Criteria 1.0-3, 1.0-4, and 1.0-5 and RL/REG-2000-08):

> *Risk Goal 1: Worker accident risk goal*
>
> *The risk to workers within the RPP-WTP Controlled Area Boundary of fatality from radiological exposure that might result from an accident shall not be a significant contributor to the overall occupational risk of fatality to workers.*

[144] See also a treatment of this subject in RL/REG-2000-15, *Regulatory Unit Position on the Achievement of Adequate Safety*, Section 3.3.1.2, RL/REG-2000-08, *Office of Safety Regulation Position on Conformance with Risk Goals*; and DOE/RL-96-0006.

The worker accident risk goal is numerically equivalent to a fatality risk of 1×10^{-5} per year from both prompt and latent cancer fatalities.[145]

Risk Goal 2: Accident risk goal

The risk to an average individual within 1 mile of the RPP-WTP Controlled Area Boundary of prompt fatalities that might result from an accident shall not exceed one-tenth of one percent (0.1%) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population generally are exposed.

The accident risk goal is considered numerically equivalent to a prompt fatality risk of 4×10^{-7} per year.

Risk Goal 3: Operations risk goal

The risk to the public and workers within 16 km (10 miles) of the RPP-WTP of cancer fatalities that might result from RPP-WTP operations shall not exceed one-tenth of one percent (0.1%) of the sum of cancer fatality risks to which members of the U.S. population generally are exposed.

The operations risk goal is numerically equivalent to a latent cancer fatality risk of 2×10^{-6} per year.

RL/REG-99-05, Section 4.9.3.3, recommends that the risk analysis requirements for the WTP facilities at the PSAR stage be limited to the following:

- Relative risk comparisons when evaluating design options during the design process
- Identification of risk-dominant events to influence the design so as to reduce the risk or uncertainty of risk
- Order-of-magnitude comparison to risk goals as a qualitative measure of the acceptability of the overall facility risk. If the results of this comparison are found to be unacceptable (i.e., estimated risk is significantly higher than the risk goals), then engineering judgment should be made as to whether a more detailed probabilistic risk analysis of selected portions of the design is appropriate to better estimate the risk and to identify design changes that appear to more closely meet the risk goals.

4.6.2 Evaluation

To assess conformance to the risk goals, the reviewers evaluated the two analyses that have been developed to provide a quantitative assessment of the facility risk (with respect to the risk goals) and establish the safety basis for the WTP: (1) the seismic probabilistic risk analysis and (2) the

[145] DOE/RL-96-0006 provides the risk goals. RL/REG-2000-15 provides guidance on numerical equivalence of these risk goals.

operations risk assessment. The results of both analyses were found to be conditionally acceptable and are summarized below:

1. **Seismic Probabilistic Risk Analysis** – The reviewers found the information on seismic probabilistic risk analysis to be conditionally acceptable. As part of establishing conformance with the risk goals in SRD Safety Criteria 1.0-3, 1.0-4, and 1.0-5, BNI performed a seismic probabilistic risk analysis of the LAW, HLW, and PT facilities to assess the risk associated with beyond-the-design-basis seismic events (PSAR Volume III, Section 3.5; PSAR Volume IV, Section 3.6; and PSAR Volume II, Section 3.6) and to provide input to the operations risk assessment (discussed in Item 2 below).

   Because of the low radiological source term in the LAW facility, the probabilistic risk analysis was conducted in a simple, conservative fashion. In the analysis, a seismically initiated failure of the LAW facility was assumed to occur with a frequency of one per year (1/yr) and involved the failure of all vessels and components, release of their radioactive contents, major damage to the room walls and penetrations, and damage to the room ventilation system such that it is nonfunctional. This approach resulted in a bounding and conservative risk estimate. For the HLW and PT facilities, a more detailed analysis was performed that included estimates of the seismic fragilities for major facility components and features such as HLW and PT shear walls, wall penetrations, and HLW and PT vessels.

   Based on a review of the PSAR for LAW, HLW, and PT facilities and the following supporting documents, the reviewers found the evaluation of the consequences of the beyond-the-design-basis earthquake for LAW, HLW, and PT facilities to be acceptable:

   - RPT-W375-NS00005, *Seismic Probabilistic Risk Analysis Methods*
   - RPT-W375-NS00006, *Methods for Assessing Consequences of Potential Accidental Radiological Releases from the RPP-WTP Facility Following a Seismic Event*
   - 24590-WTP-Z0C-W14-00002, *Radiological Source Terms for Seismic PRA*
   - 24590-LAW-Z0C-W14T-00004, *LAW Facility Dose Consequences – Requantification*
   - 24590-HLW-Z0C-W14T-00003, *HLW Facility Dose Consequences – Requantification*
   - 24590-HLW-Z0C-W14T-00018, *HLW Melter Glass Spill Decontamination Factors – Seismic PRA*
   - 24590-HLW-Z0C-W14T-00015, *HLW - Seismic PRA Requantification*
   - 24590-PTF-Z0C-W14T-00003, *Pretreatment Facility Dose Consequences – Initial Quantification*.

The results of the preliminary seismic analyses, summarized in Section 3.5 of PSAR Volume III and Sections 3.6 of PSAR Volumes II and IV, show that the risk of seismically induced radiological releases from the LAW, HLW, and PT facilities was very low compared with the risk goals (i.e., very small fraction of goals). However, the PSAR analysis did not assess the combined effects of seismically induced radiological releases from all the radiochemical process facilities that make up the WTP. In response to Question PT-PSAR-121 concerning plans to complete the combined seismic probabilistic risk analysis, BNI confirmed that no conclusions on WTP compliance to the risk goals could be made until an integrated analysis was completed, which has subsequently been completed. When contributions from seismic failures in multiple facilities (e.g., LAW, HLW, PT, and BOF) are considered, the conditional dose probabilities may increase; however, the corresponding accident sequences may become less likely and their frequencies may decrease. Consequently, a detailed probabilistic risk analysis would be necessary to determine the net effect of multiple facility failures on seismic-initiated risk.

When Revision 2 of this SER was completed, addressing LAW and HLW facility construction authorization, BNI committed to complete the seismic probabilistic risk analysis, demonstrating compliance to the risk goals (SRD Safety Criteria 1.0-3, 1.0-4, and 1.0-5) before authorization for full facility construction to understand the aggregate risk to WTP facility workers, co-located workers, and the general public from a seismic event affecting all of the facilities that comprise the WTP. This was identified as a condition of acceptance in Revision 2 of this SER and was subsequently closed.

To close the above condition, BNI produced an estimate of the aggregate risk including contributions from LAW, HLW, PT, and BOF. BNI provided documentation of the aggregate (or combined) risk on December 4, 2002, in the following documents:

- 24590-CM-HC4-HXYG-00143-01-01A, *Seismic PRA Site Risk Quantification (LAW-HLW-PT)*

- 24590-CM-HC4-HXYG-00143-01-02A, *Seismic PRA Radiological Dose Combination (LAW-HLW-PT).*

The information contained in these documents showed that the aggregate risk from the LAW, HLW, and PT facilities and BOF was very low compared with the risk goals (i.e., very small fraction of goals as shown in Table 3). The impacts from BOF were incorporated by identifying failure sequences that could impact the site-wide availability of ITS electrical power and create hazardous situations within the LAW, HLW, and PT facilities.

The seismic probabilistic risk analysis does not include the Analytical Laboratory. Reviewers found the exclusion of the Analytical Laboratory acceptable based on an estimation that the laboratory will not contribute significantly to the risk goals. This estimation was based on the following: (1) the estimated inventory of radiological and toxicological material in the Analytical Laboratory will be significantly less than that contained by the LAW facility (and the risk associated with this facility is very low);

Table 3. WTP Risk Goal Comparison Summary Table

WTP Risk Goal	Goal (Receptor Average Annual Individual Risk)	% of Goal		
		Facility	Seismic	Combined
Worker Risk Goal	1.00E-05	BOF	NA*	0.50
		LAB	TBD	TBD
		LAW	0.04	59.03
		HLW	0.003	66.42
		PT	0.04	69.57
Accident Risk Goal (Prompt Fatalities)	4.00E-07		0.00	0.00
Operations Risk Goal (normal and accident – the public and co-located worker are summed)	1.80E-06		0.13	5.44
*NA = not applicable; TBD = to be determined at a later date.				

(2) no significant energy sources are associated with the Analytical Laboratory (e.g., glass melters); and (3) no significant physical process connections (e.g., liquid waste transfer lines) are planned between the processing facilities and the Analytical Laboratory.

Results from the seismic probabilistic risk analysis estimating aggregate risk for the WTP are not documented in the PSAR. As a condition of acceptance, BNI must document the results from the integrated seismic probabilistic risk analysis in the first revision of the PSAR following authorization for full facility construction.

2. **Operations Risk Assessment** – The reviewers found the information on the operations risk assessment in the PSAR to be conditionally acceptable. During review of the LAW and HLW facility submittal, reviewers questioned (Question HLW-PSAR-206) discrepancies in CSD records between the PSAR and the operations risk assessment. In response, BNI committed to address these inconsistencies to update the operations risk assessment to document a fully integrated facility-wide analysis that would include a consistent CSD record for LAW, HLW, and PT facilities before authorization for full facility construction. The results of this fully integrated facility-wide analysis, along with the combined results of the seismic probabilistic risk analysis (discussed previously in this section), would provide a current estimate of performance against the risk goals for the integrated WTP facility. This was identified as a condition of acceptance in Revision 2 of this SER and was subsequently closed.

To close the above condition, BNI provided 24590-WTP-U7C-50-00001 to DOE on December 3, 2002. That report was developed for the overall WTP facility to confirm that the facility would meet the radiological exposure standards in SRD Safety Criterion

2.0-1 and the associated risk goals. The reviewers evaluated the information in 24590-WTP-U7C-50-00001, as described below.

As discussed in Section 4.6.1 in this SER, only an order-of-magnitude measure of facility risk was required at the PSAR stage of the project. BNI used available hazard analysis information (e.g., SIPD entries), conservative assumptions, and the seismic risk assessment to determine quantitative conformance to the risk goals. This approach met the intent of providing an order-of-magnitude measure of the facility risks.

The operations risk assessment used design information from SIPD that was current as of August 19, 2002, and that reflected potential design changes from the PSAR. The major differences between PSAR design and the current operations risk assessment are as follows:

- Two trains of ITS power (with two EDGs) instead of three
- Removal of all permanently installed area radiation monitors and continuous air monitors
- Removal of all LAW interlocks
- Reduction of HLW and PT interlocks.

These changes result in a less conservative design compared with the PSAR preliminary design. Therefore, the PSAR design would have lower operations risk. However, the effect on risk from these changes to the PSAR design have not been evaluated. The results, shown in Table 3, indicate that the combined risk results for the August 19, 2002, operations risk assessment design are approaching the risk goal budget for the worker risk goal. The reviewers found the WTP risk results acceptable for this phase of design because the risk goals are being met and there are no known significant risk contributors, that will prevent the WTP from meeting the prescribed risk goals as the design is refined.

BNI assessed the impacts on the facility risk goals from BOF systems and facilities by performing dependency analyses associated with the failure of common support systems such as electrical, raw water, and compressed air supplies serving the LAW, HLW, and PT facilities. These impacts on the risk of the LAW, HLW, and PT facilities were quantified in the seismic probabilistic risk analysis and operations risk assessment and are included in the summary results shown in Table 3. The reviewers found this approach acceptable for LAW, HLW, and PT facility evaluations. It was recognized that the aggregate effects of common-mode failures from BOF systems and facilities as they may affect all of the WTP facilities had not been evaluated yet and may result in minor changes to the risk values shown in Table 3. This will be addressed through the continued development of the seismic probabilistic risk analysis and operations risk assessment leading up to the Operations Authorization Request. However, the conclusions reached in this SER section are not expected to change.

Results from the integrated facility-wide operations risk assessment are not documented in the PSAR. As a condition of acceptance, BNI should document the results from the integrated operations risk analysis in the first revision of the PSAR following authorization for full facility construction.

By identifying risk-dominant events, as found in the analysis of the operations risk assessment, the design of facilities can be influenced to reduce the risk or uncertainty of risk. PSAR Volume IV, Table 3-19, and PSAR Volume II, Table 3A-21, identified risk dominant events for HLW and PT facilities, respectively; however, PSAR Volume III, addressing the LAW facility, did not include a similar listing. During review of the LAW and HLW facility submittals, in response to Question LAW-PSAR-168 concerning this inconsistency, BNI committed to include a table of the risk dominant events for the LAW facility in the first PSAR revision following authorization for full facility construction. This commitment, documented as a condition of acceptance in Revision 2 of this SER, was subsequently closed.

To close the above condition, BNI identified risk-dominant events in Section 10.6 of 24590-WTP-U7C-50-00001. This information can be used to support design of the WTP facility to reduce the risk or uncertainty of risk. Reviewers found this information generated for the operations risk assessment acceptable. However, the LAW risk dominant events still are required to be documented in the first revision of the PSAR following authorization for full facility construction.

4.6.3 Conclusions

The reviewers concluded that the results of the seismic and operations risk analyses currently indicate that the risk goals were met for the facility; however, uncertainty is associated with these results. All potential common-cause failures and WTP final control strategies are not defined because the WTP design is still evolving. The preliminary results indicate that there are no known significant risk contributors that will prevent the WTP from meeting the prescribed risk goals.

Conditions of Acceptance – BNI must complete the following actions by the date or milestone indicated:

1. Complete the seismic probabilistic risk analysis, demonstrating compliance to the risk goals of SRD Safety Criteria 1.0-3, 1.0-4, and 1.0-5 (excluding the Analytical Laboratory). This must be completed before authorization for full facility construction. (COMPLETE) (See Section 4.6.2, Item 1.)

2. Include in the first PSAR revision following authorization for full facility construction, a table of risk dominant events for the LAW facility, as committed to in response to Question LAW-PSAR-168. (COMPLETE) (See Section 4.6.2, Item 2.)

3. Update the operations risk assessment to document a fully integrated facility-wide analysis that would include LAW, HLW, and PT before full facility construction

authorization, as committed to in response to Question HLW-PSAR-206. (COMPLETE) (See Section 4.6.2, Item 2)

4. Document the results from the integrated seismic probabilistic risk analysis and operations risk assessment in the PSAR in the first revision of the PSAR following authorization for full facility construction. (See Section 4.6.2, Items 1 and 2.)

5.0 EVALUATION - CAR CONTRACT DELIVERABLES

The following 11 documents are Contract requirements for BNI construction authorization:

- Construction Occurrence Reporting Plan (Final)
- Operating Authorization Request Outline
- Emergency Response Plan (Draft)
- Conduct of Operations Plan (Draft)
- Training and Qualification Plan (Draft)
- Maintenance Implementation Plan (Draft)
- Occurrence Reporting Plan (Draft)
- Deactivation Plan (Draft)
- Environmental Radiological Protection Program (Draft)
- Technical Safety Requirements (Draft)
- Plan for Operational Assessment Reports (Draft).

The 11 documents were initially submitted to ORP on January 25, 2002,[146] and January 31, 2002.[147] Evaluation of all but the draft TSRs is discussed in the following sections. The draft TSRs were phased submittals for the specific facilities and were evaluated as part of the specific facility evaluations (see Sections 4.1.4, 4.2.4, and 4.3.4 of this SER).

The plans were reviewed for acceptability as draft plans. BNI should correct the deficiencies before submittal and approval of the final plans with the request for authorization for production operations (DOE/RL-96-0003, Section 4.4, "Authorization for Production Operations").

5.1 Construction Occurrence Reporting Plan (Final)

The purpose of this review was to determine whether the PSAR adequately described the plans and procedures that addressed incident reporting and investigation related to radiological, nuclear, and process safety during the project's construction phase.

5.1.1 Requirements

The BNI Contract, Section C, Standard 7, Table S7-1, contains the requirements for a Construction Occurrence Reporting Plan and requires that a final Construction Occurrence Reporting Plan be submitted and approved at the start of construction. Section C, Standard 1, of the Contract further specifies that occurrence reporting will adhere to DOE M 232.1-1A.

[146] CCN: 026384, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Contract Deliverables due with Construction Authorization Request for the Hanford Waste Treatment and Immobilization Plant," dated January 25, 2002.
[147] CCN: 027627, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant," dated January 31, 2002.

RL/REG-99-05, Section 3.7.3.2, "Regulatory and Contractual Requirements," provides guidance on occurrence reporting and states that (1) the program should address reporting of noncompliances with DOE nuclear safety requirements to ORP Price Anderson Amendment Act Coordinator and DOE's Office of Price-Anderson Enforcement; (2) the incident reporting program, including identifying, tracking, and implementing corrective actions taken in response to incidents, should be consistent with the QAM (and subpart A of 10 CFR 830); (3) the program should meet requirements for reporting and incident investigation as described in the SRD, Section 7.7, "Reporting and Incident Investigation"; and (4) the program should address discovery of programmatic safety issues as well as ITS events. This guidance was written for the draft Occurrence Reporting Plan but applies equally to the final Construction Occurrence Reporting Plan.

5.1.2 Evaluation

A Construction Occurrence Reporting Plan for Limited Construction[148] was submitted to ORP with BNI's LCAR. ORP[149] accepted the plan for use during limited construction. The plan used procedure 24590-WTP-GPP-SIND-001-0, which DOE[150] previously approved to implement incident reporting and investigations. Question LAW-PCAR-037 was asked to clarify whether this same procedure would be applied to partial construction activities. In response, BNI re-evaluated the procedure for hazards and activities associated with work performed during partial construction. BNI committed to use the approved Construction Occurrence Reporting Plan for Limited Construction for the partial construction activities.[151]

The reviewers evaluated 24590-WTP-PL-CN-01-002, *Construction Occurrence Reporting Plan*, for full construction and found it to be acceptable. The plan established a system for the timely identification, categorization, and reporting of occurrences according to DOE O 232.1A and its associated manual, DOE M 232.1-1A. The plan also stated that requirements in the plan would be implemented in 24590-WTP-GPP-SIND-001-0. Section 1.3.6 of the plan stated that off-normal occurrences would be reported to the Price Anderson Amendment Act Coordinator as soon as possible, while Section 1.3.8 stated that corrective actions identified as a result of the occurrence would be placed in the Corrective Action Management System, per the QAM, Policy Q-16.1 on corrective actions, and Subpart A of 10 CFR 830. Finally, BNI's reporting program was found to be consistent with the safety criteria in the SRD, Section 7.7, "Reporting and Incident Investigation."

[148] CCN: 021691, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Supplement to Response to U.S. Department of Energy, Office of Safety Regulation Question 01-LCAR-001 on the Limited Construction Authorization Request," dated July 26, 2001.
[149] 01-OSR-0310, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Office of Safety Regulation Safety Evaluation Report of the Limited Construction Authorization Request," dated August 16, 2001.
[150] 01-OSR-0369, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Office of Safety Regulation (OSR) Approval of Contract Deliverable Item 1.8, Occurrence Reporting," dated September 20, 2001.
[151] CCN: 034602, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Response to Safety Evaluation Report Conditions for Acceptance Before Authorization for Construction of the Basemat for the High Level Waste and Low-Activity Waste Partial Construction Authorization Request," dated June 20, 2002.

The reviewers also evaluated the occurrence reporting process as described in PSAR Volume I, Section 17.4.7, and found it to be acceptable. The PSAR stated that the occurrence reporting process was applicable to the project's design and construction phases including cold commissioning and that this scope was consistent with the project's Construction Occurrence Reporting Plan. The PSAR further stated that the WTP project occurrence reporting program provided for timely identification, categorization, response, notification, investigation, and reporting of abnormal events and conditions, including processing that information to identify the root cause, direct cause, and contributing cause and to develop appropriate corrective actions to prevent recurrence. Section 17.4.7 also stated that the occurrence reporting process was established in a project plan and procedure according to the requirements of DOE O 232.1A and its associated manual, DOE M 232.1-1A and that an evaluation would be conducted for repeat occurrences to determine if the trend represented a programmatic failure.

The reviewers determined that the construction occurrence reporting program acceptably addressed the following:

- The types of incidents that could be encountered during construction
- Criteria for reporting incidents and methodology to appropriate regulatory authorities
- Timeliness criteria for reporting incidents
- How incident reports will be initiated, reviewed, and approved
- How incidents will be investigated
- How incident causes will be determined and appropriate corrective actions identified
- BNI's responsibility assignments for incident reporting and investigation.

5.1.3 Conclusion

The reviewers concluded that the Construction Occurrence Reporting Plan was acceptable. The construction occurrence reporting procedure and Section 17.4.7 of the PSAR were consistent with the plan, and all three documents met the requirements of an acceptable construction occurrence reporting program.

5.2 Operating Authorization Request Outline

The purpose of this review was to determine whether BNI's outline of the Operating Authorization Request (OAR) detailing the planned submittal acceptably addressed the requirements specified in DOE/RL-96-0003. The OAR will be submitted for approval before hot operations.

5.2.1 Requirements

DOE/RL-96-0003, Section 3.3.4, "Authorization for Production Operations," contains the requirements for an OAR outline and states, "the purpose of the Authorization for Production Operations regulatory action is to authorize the Contractor to begin introducing significant quantities of high-level radioactive waste into its facility." Section C, Standard 7, Table S7-1 of

the BNI Contract requires completion and submittal of an OAR outline at the start of construction.

The OAR outline should be similar to the structure of the PSAR submitted by BNI for construction authorization. The outline is acceptable if it addresses production operation aspects that impact the safety of the facility and co-located workers, the public, and the environment. RL/REG-99-05, Section K, "Outline of Operating Authorization Request," provided further guidance for the outline's content. DOE/RL-96-0003, Section 4.4.2, "Contractor Input," specified 16 items to be included in the FSAR portion of the OAR and an additional 9 items to be included, but not as part of the FSAR.

5.2.2 Evaluation

The reviewers evaluated the OAR outline submitted January 25, 2002, against the applicable criteria defined in RL/REG-99-05 and found it to be acceptable. The outline indicated that the OAR will adequately address the objectives of protecting the facility and co-located workers, the public, and the environment during production operations. The outline indicated that the OAR would consist of two parts: (1) the FSAR and (2) other OAR submittals as outlined in DOE/RL-96-0003.

The format and content of the FSAR will be that specified in the SRD, Appendix G, "Ad Hoc Implementing Standard for Safety Analysis Reports." This appendix was previously approved by ORP for format and content[152] and was acceptable to the reviewers.

The proposed outline for the OAR contained the following elements for the FSAR:

1. A facility-specific executive summary that introduces the differences in design and construction between what was presented in the PSAR and what is presented in the FSAR; that identifies the planned administrative controls between the PSAR and FSAR; and that concludes the SRD requirements and commitment to adequately protect the public, the facility and co-located workers, and the environment will be achieved.

2. A general description of the WTP site in terms of its location and site characteristics similar to what exists in the PSAR. The FSAR will identify significant differences from the PSAR in the site (e.g., new NPH data, if any) and the planned use of the site as the differences might impact the WTP.

3. A description of the facility structures (including facility and process drawings and fabrication and construction specifications ITS analysis of the facilities), the operation of the chemical processes, and design and operation of the waste handling and treatment processes. The facility-specific volumes will provide results of civil/structural analyses and building settlement data collected during construction.

[152] 02-OSR-0034, ORP letter from R. C. Barr, to R. F. Naventi, BNI, "Approval of Bechtel National, Inc. (BNI) Authorization Basis Change Notice, ABCN-24590-01-0004, Rev. 2., Identification of Safety Analysis Report (SAR) Format and Content," dated January 29, 2002.

4. Identification of the hazard and accident analysis for the completed facilities, including identification and description of the potential accident/event sequences and control strategies required to prevent or mitigate them. A set of DBEs will be identified, including the ITS SSCs, administrative controls, and TSRs required to prevent or mitigate the DBEs.

5. A description of the SSCs applicable to operations.

6. Identification of TSRs necessary to support operations.

7. A discussion of what, if any, criticality control measures are necessary for operations. The submittal will include an update of the *Criticality Safety Evaluation Report*, as well as more information on the independent sampling of the feed material for fissile material content.

8. An updated description of the radiation protection program, hazardous material protection programs, and radioactive and hazardous waste management programs.

9. A summary of the preoperational testing program, including reference to the final MIP.

10. A summary of the CONOPS, procedures, and training programs necessary to support operations.

11. A summary of human factors, QA, and fire protection measures in place for operations.

12. A summary of the emergency management program required for operations, including an update of the hazard survey and hazard assessment and additional detail on the facility-specific aspects of the WTP emergency management program.

13. A summary of the provisions for deactivation, including a description of the administrative controls to be put in place during facility operations to assist in decontamination and deactivation.

14. A summary of management, organizational, and institutional safety provisions necessary for preoperational testing and operations. The FSAR will address organizational structure, roles, and responsibilities; staffing and qualifications; safety review performance assessments; CM, document control, and records management; occurrence reporting; incident investigation; lessons learned; feedback; and trending necessary to support operations.

In addition, the outline indicated that the following documentation will be submitted separate from the FSAR:

1. A final Training and Qualification Plan

2. Revision of the SRD, as necessary, for operations

3. Revision of the ISMP, as necessary, for operations

4. An assessment of BNI's compliance to the SRD and ISMP for operations

5. The technical and experience qualifications of the operating Contractor

6. A description of the ITS testing program

7. Documentation of the effectiveness of the QA program implementation in ensuring that the facility was constructed as intended

8. A final USQ Plan

9. A final MIP

10. A final Occurrence Reporting Plan and occurrence reporting procedures

11. A final ERPP for operations

12. A final Radiation Protection Plan for operations

13. A final Emergency Response Plan and implementing procedures for operations

14. Evidence that the intended emergency response program is qualified and functional before facility operations

15. A description of the final physical protection program and the associated physical and administrative features

16. A commitment to comply with the provisions of the regulatory oversight program

17. A revision to the Hazard Analysis Report (this was subsequently incorporated into the PSAR so is no longer a required submittal)

18. A revision to the Deactivation Plan

19. A revision to the QAM

20. A final plan for Operational Assessment Reports

21. A draft Deactivation Safety Assessment document

22. A final CONOPS Plan

23. TSRs for the operating facilities.

The reviewers noted that the OAR outline committed to provide the FSAR in a format previously approved by DOE; the additional information identified in DOE/RL-96-0003 necessary for approval of the OAR; and the documentation identified in the BNI Contract, Section C, Standard 7, Table S7-1. The outline addressed all of the required submittals.

5.2.3 Conclusions

The reviewers concluded the OAR outline described above was acceptable.

5.3 Emergency Response Plan (Draft)

The purpose of this review was to determine whether the CAR contained an acceptable draft Emergency Response Plan.

5.3.1 Requirements

The Contract, Section C, Standard 7, Table S7-1, contains the CAR requirements for a draft Emergency Response Plan and requires a draft plan be submitted and approved before the start of construction. Table S7-1 required the Emergency Response Plan to comply with the requirements of DOE/RL-94-02, as well as with 40 CFR 68,40 CFR 355, 29 CFR 1910.38, and WAC 246-247. The requirements contained in the latter documents are also contained in either DOE/RL-94-02 or in a template generated for Hanford contractors (HNF-IP-0263-GEN). The template states that a Building Emergency Plan is used to demonstrate compliance with emergency preparedness planning requirements at hazardous facilities, as defined in DOE/RL-94-02. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item E, requires BNI to submit a draft Emergency Response Plan with its CAR.

RL/REG-99-05, Section 9.0, "Emergency Management," and Section I, "Draft Emergency Response Plan," provides further guidance on emergency management. The RL/REG-99-05 guidance references SRD Safety Criteria 7.8-1 through 7.8-5 and Sections 1.3.18 and 3.10 of the ISMP as implementing codes and standards for the safety criteria. However, on October 19, 2001,[153] BNI submitted an ABCN that proposed replacing Safety Criteria 7.8-2 through 7.8-5 and with DOE/RL-94-02. Also, Safety Criterion 7.8-1 was revised to include the DOE/RL-94-02 criteria as requirements for emergency preparedness. ORP approved the ABCN on June 18, 2002.[154] Therefore, the review used DOE/RL-94-02 requirements for the evaluation.

[153] CCN: 023762, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Approval: Authorization Basis Change Notice 24590-WTP-ABCN-ESH-01-003, Rev. 0, Selection of Implementing Standard for Emergency Preparedness," dated October 19, 2001.

[154] 02-OSR-0232, ORP letter from R. C. Barr to R.F. Naventi, BNI, "Approval of Bechtel National, Inc. (BNI) Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-003, Revision 0, 24590-WTP-ABCN-ESH-01-008, Revision 1, 24590-WTP-ABCN-ESH-02-011, Revision 0, 24590-WTP-ABCN-ESH-02-013, Revision 0," dated June 18, 2002.

The requirements for emergency management and the draft Emergency Response Plan are complementary. For convenience, both the emergency management section (Section 3.15 of this SER) and the draft Emergency Response Plan were evaluated using the criteria for emergency management because these criteria were consistent with DOE/RL-94-02. The Emergency Response Plan describes how the commitments made in the PSAR are to be implemented. The final Emergency Response Plan was acceptable if it met the following evaluation criteria:[155]

1. **Hazard Assessment** – BNI provided an adequate hazard assessment that is used to design the emergency management program.

2. **Emergency Response Organization** – BNI presented an emergency response organization with clearly defined roles commensurate with the conclusions of the hazards assessment and are adequate to manage and control emergency response at the facility.

3. **Offsite Response Interfaces** – BNI adequately obtained commitments from outside organizations to provide data and services to satisfy safety obligations and coordinated its emergency management with the DOE Hanford Site and local community emergency response plans.

4. **Categorization and Classification of Operational Emergencies** – BNI adequately provided for categorizing reportable incidents as soon as reasonably possible and in all cases within two hours of the event.

5. **Notification and Communications** – BNI adequately provided for timely notification and communications to the emergency response organization, facility and co-located workers, offsite response agencies, and the public.

6. **Consequence Assessment** – BNI adequately provided for timely, continuous, and appropriate consequence assessments.

7. **Protective Actions and Re-Entry** – BNI provided adequate and appropriate protective action guidance and implementation and re-entry planning.

8. **Emergency Medical Support** – BNI provided for adequate emergency medical support commensurate with the findings of the hazards assessment.

9. **Emergency Public Information** – BNI provided for adequate emergency public information in the areas of facilities, equipment, personnel, and public education.

10. **Emergency Facilities and Equipment** – BNI designed the control room or control area to permit occupancy and actions to be taken to monitor the facility safely during normal operations and to provide safe control for anticipated accident conditions. BNI evaluated the need for an alternate system that would allow the process to be placed in a safe state if the primary control area is uninhabitable.

[155] RL/REG-99-05, Section 9.3.3, "Regulatory Acceptance Criteria."

11. **Termination and Recovery** – BNI adequately provided for terminating operational emergencies and recovering and resuming normal operations.

12. **Program Administration** – BNI described the emergency management program and provided for periodic audits and assessments.

13. **Training and Drills** – BNI adequately described the emergency preparedness training program to provide initial and annual refresher training for the emergency response organization, general employees, and response personnel from other agencies.

14. **Exercises** – BNI had adequate plans and resources to periodically exercise the Emergency Response Plan to ensure that protective measures can be implemented in the event of an accident.

5.3.2 Evaluation

The reviewers found 24590-WTP-PL-OP-01-003, *River Protection Project – Waste Treatment Plant Emergency Response Plan*, to be acceptable for a draft plan. However, changes noted in the evaluation should be included in the final plan. The draft Emergency Response Plan followed the format from HNF-IP-0263-GEN and therefore met the requirements of DOE/RL-94-02, 40 CFR 68, 40 CFR 355, 29 CFR 1910.38, and WAC 246-247. When operational, the WTP will be owned by DOE and operated by a contractor. Therefore, WTP emergency preparedness will be part of, and integrated with, Hanford emergency preparedness and the emergency preparedness document, DOE/RL-94-02.

The 14 areas of a draft Emergency Response Plan were evaluated separately, and the evaluation of the information for each review criterion is summarized below:[156]

1. **Hazard Assessment** – The reviewers found the hazard assessment discussion to be acceptable for a draft plan. Section 5 of the plan generally discussed the hazards that pose significant risks to human health or the environment. Section 5 also stated that before the plan is implemented and the bulk quantities of hazardous chemicals are introduced into the WTP, additional information will be provided in Section 5.

   PSAR Section 15.4.2.3 also discussed the hazard assessment, providing a matrix of accidents, accident types, consequences, and protective actions (see Section 3.15 of this SER). The reviewers found this acceptable because the plant design is preliminary and BNI will not be able to provide a final hazard assessment until the design is complete.

2. **Emergency Response Organization** – The reviewers found the discussion of the emergency response organization, as found in Section 3 of the plan, to be acceptable for a draft plan. The organization will have, among other personnel, a Building Emergency Director, an Incident Command Post hazards communicator, an Incident Command Post communicator, and a hazards assessor (chemical or radiological or both, depending on

[156] Except for element 1, "Hazard Assessment," the elements were also listed in DOE/RL-94-02.

the event). The plan noted that the WTP emergency response organization, as described in Section 3 of the plan and in Section 2.2 of DOE/RL-94-02, will be available 24 hours a day to respond to events at the plant. The plan also noted the Building Emergency Director will be prepared to carry out the duties immediately and whenever an imminent or actual emergency exists.

PSAR Section 15.4.1 also discussed the emergency response organization and described the responsibilities of key individuals (see Section 3.15 of this SER).

3. **Offsite Response Interfaces** – The reviewers found the discussion of offsite response interfaces to be acceptable for a draft plan. Section 10 of the plan stated that DOE had established a number of coordination agreements, or memoranda of understanding, with various agencies to ensure that proper response was available. These agreements were described in DOE/RL-94-02, Section 3.0, Table 3-1. Because BNI is one of several Hanford contractors, it is an integral part of DOE/RL-94-02 and can use the DOE coordination agreements in DOE 94-02. (Separate coordination agreements with offsite agencies do not need to be established.)

   PSAR Section 15.4.1 also described the integrated emergency response organization (see Section 3.15 of this SER).

4. **Categorization and Classification of Operational Emergencies** – The reviewers found the categorization of operational emergencies to be acceptable for a draft plan. Section 6.0 of the plan described potential emergency conditions but did not contain any facility-specific emergency action levels because the hazards assessment has not yet been completed (nor was it required to be completed at this stage of construction). Question LAW-PSAR-129 was asked to clarify the lack of emergency action levels. In response, BNI clarified that such levels would be developed based on the outcome of the hazards assessment and that WTP-specific emergency action levels will be developed into a DOE/RL emergency response procedure specific to the WTP. This commitment was acceptable to the reviewers and should be included in the final Emergency Response Plan.

   The process used to categorize emergencies was also discussed in PSAR Section 15.4.2 (see Section 3.15 of this SER).

5. **Notification and Communications** – The reviewers found the discussion of notification and communications to be acceptable for a draft plan. Section 9.6 of the plan implemented this requirement by noting that a primary Incident Command Post with alternate Incident Command Posts was to be determined at the time of an emergency, if necessary. Question LAW-PSAR-131 was asked to clarify the location of alternate Incident Command Posts. In response, BNI stated it would use the Hanford Site Mobile Incident Command Post that could be deployed, when necessary, in the field. However, no formal mechanism or procedure is in place for using the van as an alternate Incident Command Post for the WTP. BNI should put a formal agreement in place for using the Hanford Site mobile van as an Incident Command Post for the WTP when the Emergency Response Plan is finalized.

Notification and communications were also discussed in PSAR Section 15.4.2.3 (see Section 3.15 of this SER).

6. **Consequence Assessment** – The reviewers found the discussion of consequence assessment acceptable for a draft plan. Although the plan did not explicitly discuss implementing criteria for this requirement, DOE/RL-94-02 stated in Section 6.2 that the Unified Dose Assessment Center had the primary responsibility for overall onsite and offsite consequence assessment for the Hanford Site. The Center staff continuously assess event conditions that may include release terms, mitigation efforts, onsite and offsite field team data, and meteorological conditions. As noted previously, BNI is part of the Hanford emergency response organization and therefore the Center would be responsible for the WTP consequence assessment.

   Consequence assessment was also discussed in PSAR Section 15.4.2.3 (see Section 3.15 of this SER).

7. **Protective Actions and Re-Entry** – The reviewers found the discussion of protective actions and re-entry, as found in Section 7 of the plan, to be acceptable for a draft plan. Section 7 stated that DOE/RL-94-02 provided a concept of operations for emergency response and that site-specific procedures are detailed in DOE-0223, which BNI will use, as necessary. It also stated that facility-specific actions will be denoted in WTP emergency response procedures before WTP operation and that procedure titles will be included in an appendix to the plan when it is revised before bulk quantities of hazardous chemicals are introduced into the WTP.

   Protective actions and re-entry were also discussed in PSAR Sections 15.4.5 and 15.4.7 (see Section 3.15 of this SER).

8. **Emergency Medical Staff** – The reviewers found the discussion of emergency medical staff to be acceptable for a draft plan. Section 10 of the plan referenced DOE/RL-94-02 for coordinating agreements and memoranda of understanding with various agencies. However, Section 10 did not discuss onsite medical support. Question LAW-PSAR-129 was asked to clarify onsite medical support. In response, BNI stated that onsite medical support will be performed by the Hanford Fire Department through the Site services contract mechanism that BNI has with Fluor Hanford. The Hanford Fire Department's capabilities are documented in DOE/RL-94-02.

   Emergency medical support was also discussed in PSAR Section 15.4.4 (see Section 3.15 of this SER).

9. **Emergency Public Information** – The reviewers found the discussion of emergency public information to be acceptable for a draft plan. The plan did not explicitly reference this subject because BNI believed it was adequately covered in DOE/RL-94-02. Question LAW-PSAR-129 was asked to clarify emergency public information. In response, BNI stated that while DOE/RL had the responsibility for staffing and operating the Joint Information Center, BNI had certain responsibilities to support DOE/RL in specific positions. The response concluded that "integration of BNI personnel with

DOE/RL will help ensure that the public information program for the project is established and maintained … ." This commitment was acceptable to the reviewers and should be included in the final Emergency Response Plan.

Emergency public information was also discussed in PSAR Section 15.4.1.3 (see Section 3.15 of this SER).

10. **Emergency Facilities and Equipment** – The reviewers found the discussion of emergency facilities and equipment to be acceptable for a draft plan. As one of the Hanford contractors and as part of DOE/RL-94-02, BNI will rely on many of the DOE emergency facilities, such as the Hanford Emergency Operations Center, the Patrol Operations Center, the Occurrence Notification Center, and emergency medical facilities of the Hanford Fire Department. It will also have its own onsite health care center and personnel decontamination facility.

    The draft plan stated that a list of emergency equipment would be developed and finalized in the plan before hot commissioning. Currently, the plan discusses such equipment in Section 9, where it lists fixed emergency equipment, portable emergency equipment, communications equipment/warning systems, personal protective equipment, and spill control and containment supplies.

    With respect to an alternate system to maintain control of the WTP, as noted in Section 5 above, BNI responded to Question LAW-PSAR-131 that the location of the Incident Command Post had not been finalized but that it will contain the necessary pre-installed equipment to perform emergency functions. Furthermore, the Incident Command Post will use the Hanford Site Mobile Incident Command Post, which could be deployed, when necessary, in the field as an alternate location. As noted in Item 5 above, BNI should put in a formal agreement in place for using the Hanford Site mobile van as an Incident Command Post for the WTP when the Emergency Response Plan is finalized.

    Emergency facilities and equipment were also discussed in Section 15.4.4 of the PSAR (see Section 3.15 of this SER).

11. **Termination and Recovery** – The reviewers found the discussion of termination and recovery to be acceptable for a draft plan. Section 8 of the plan described BNI's process for terminating an emergency, stating that if the WTP Emergency Response Plan is implemented according to the guidelines in Section 4 of the implementing procedure, the Washington State Department of Ecology (Ecology) must be notified before operations can resume. This was acceptable to the reviewers.

    PSAR Section 15.4.7 also described emergency termination, re-entry, and recovery and stated that predetermined criteria for terminating emergencies will be developed and maintained in the WTP emergency plan implementing procedures and will be consistent with the Hanford Site emergency procedures. Re-entry and recovery will include notifications associated with terminating an emergency and establishing criteria for resuming normal operations.

12. **Program Administration** – The reviewers found the discussion of program administration to be acceptable for a draft plan. However, neither the PSAR nor the implementing procedure discussed or described administering the emergency preparedness program. Question LAW-PSAR-012 was asked to clarify program administration. In response, BNI stated that PSAR Section 15.3 will be revised to reflect that Section 14 of DOE/RL-94-02 and its requirements will be contained as part of the plan. Question LAW-PSAR-129 was asked to clarify the absence of information concerning program administration in the plan. In response, BNI also stated that the WTP will comply with the applicable portions of DOE/RL-94-02, Section 14, including providing WTP input to the Hanford Emergency Readiness Assurance Plan. BNI also will develop an internal assessment of the emergency preparedness activities program and will implement it before cold commissioning. A vital records program will be developed to ensure documents essential to the continued functioning of WTP are available during and after an emergency. This commitment was acceptable to the reviewers and should be included in the final Emergency Response Plan.

13. **Training and Drills** – The reviewers found the discussion of training and drills to be acceptable for a draft plan. PSAR Section 15.4.6 adequately described the training and drills requirements. However, the draft plan did not discuss or describe training and drills. Question LAW-PSAR-129 was asked to clarify this absence. In response, BNI stated that training and drills will be conducted using DOE G-151.1, Volume V, Section 4.0, "Training and Drills," as a guide. The emergency manager will periodically assess the drill and training program, and the results will be used to improve the program. All identified deficiencies from drills will be compiled in a database and tracked until adequate corrective actions are implemented. Management will attend emergency response training to determine where enhancements can be made to ensure that proper training is provided. This commitment was acceptable to the reviewers and should be included in the final Emergency Response Plan.

14. **Exercises** – The draft plan did not discuss exercises, but the commitments in PSAR Section 15.4.6.2 were acceptable to describe the exercise commitments required in the final Emergency Response Plan. Question LAW-PSAR-129 asked to clarify this discrepancy. In response, BNI stated that it will conduct exercises according to the requirements of DOE/RL-94-02 and RLEP 3.10. Also, PSAR Section 15.4.6.2 adequately described the exercise program and stated that a formal exercise program will be documented in an implementing procedure, exercises will be critiqued, and corrective actions will be identified.

5.3.3 Conclusions

The reviewers concluded that the draft Emergency Response Plan was acceptable for a draft plan. Specific commitments were discussed in the evaluation that should be included in the final Emergency Response Plan for it to be acceptable.

5.4 Conduct of Operations Plan (Draft)

The purpose of this review was to determine whether BNI had an acceptable draft CONOPS Plan. The draft plan should contain the basic elements for CONOPS as outlined in SRD Safety Criterion 7.5-2.

5.4.1 Requirements

The Contract, Section C, Standard 7, Table S7-1, contains the requirements for a draft CONOPS Plan and requires a draft plan be submitted and approved at the start of construction. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item A.18.b, also requires the draft CONOPS Plan to be submitted and approved as part of the CAR.

RL/REG-99-05, Section 3.11, "Operational Practices," provides further guidance on the CONOPS Plan and states that the plan should include the 19 elements of CONOPS described in SRD Safety Criterion 7.5-2. The final CONOPS Plan was acceptable if it met the following evaluation criteria:

1. **Operations Organization and Administration** – BNI described its commitment to a high level of performance, including an organization and administrative portion, in its operations.

2. **Shift Routines and Operating Practices** – BNI described how shift routines and operating practices are used to define standards for professional conduct to ensure that operator performance meets facility management, customer, and regulator expectations. Procedures are used to describe aspects of routine operating staff activities that are ITS.

3. **Control Area Activities** – BNI described how control area activities, both control room and local workstations, are conducted in a manner that ensures safe and reliable facility operations.

4. **Communications** – BNI described both the systems and administrative processes for controlling communications to ensure that reliable communications are available and properly used in normal and emergency conditions.

5. **Control of On-Shift Training** – BNI described its on-shift training program, tailored to the individual facility. (This may be covered here or in the overall training program.)

6. **Investigation of Abnormal Events** – BNI described how it investigates abnormal events, including defining which events need to be investigated.

7. **Notification** – BNI described its notification program, including notification procedures and responsibility for notifications.

8. **Control of Equipment and System Status** – BNI described the elements of equipment and system status, ensuring that facility configuration is maintained according to design requirements.

9. **Lockout and Tagout** – BNI described its lockout/tagout program, which is applicable to servicing and maintenance situations where inadvertent energizing or startup of equipment or release of stored energy could injure employees.

10. **Independent Verification** – BNI described its independent verification program, which provides a high degree of reliability in ensuring the correct facility operation and the correct position of ITS components such as valves, switches, and circuit breakers.

11. **Logkeeping** – BNI listed and described its administrative program for key shift positions required to maintain a narrative log of the facility's status and all events required to provide an accurate history of facility operations.

12. **Operations Turnover** – BNI described how to provide the oncoming shift operators with an accurate picture of the overall facility status. Turnover guidelines are established and proceduralized to ensure that information required to adequately perform shift operations is documented by the offgoing shift and reviewed by the oncoming shift. Therefore, the operations personnel of the oncoming shift have an accurate picture of overall facility status.

13. **Operations Aspects of Facility Chemistry and Unique Processes** – BNI described the operational aspects of the facility chemistry, including operator responsibilities and responses to problems.

14. **Required Reading** – BNI described how shift personnel are kept current with important information related to their job assignments through a required reading program. The required reading program provides a method for various types of information applicable to the WTP to be disseminated to pertinent personnel.

15. **Timely Orders to Operators** – BNI described control of timely order to operators, including how short-term information and administrative instructions are communicated to shift operations personnel. Timely orders are used by management to rapidly disseminate essential daily or long-term directions, instruction, or information to operating personnel to support operational activities.

16. **Operations Procedures** – BNI described its commitment to operational procedures (including emergency operating procedures) to provide appropriate direction to ensure that the facility is operated within its design basis and, when effectively implemented, to ensure the facility's safe operation.

17. **Operator Aid Posting** – BNI described how information useful to operators performing their duties is provided in a controlled fashion.

18. **Equipment and Piping Labeling** – BNI described what is done to help ensure that facility personnel are able to positively identify equipment they operate. This includes use of a standardized equipment labeling program to ensure that facility personnel are able to positively identify specific pieces of facility equipment.

19. **Emergency Operating Procedures for Dealing with Responses to Accident Conditions** – BNI provided guidance in distinguishing between emergency response procedures and responding to single and multiple off-normal conditions.

5.4.2 Evaluation

The reviewers evaluated 24590-WTP-PL-OP-01-002, *WTP Conduct of Operations Plan*, for full construction and found it to be acceptable as a draft plan. However, changes noted in the evaluation should be included in the final plan. The draft CONOPS Plan addressed all 19 criteria listed in Section 5.4.1 of this SER. Where applicable, elements of the draft CONOPS Plan were consistent with other authorization basis documents and requirements, including the PSAR and the QAM. The draft plan contained 19 elements, each with a stated objective and a set of criteria designed to accomplish the objective. These elements align with those required by SRD Safety Criterion 7.5-2, which requires that the CONOPS program address each one. By addressing each element required by the SRD, the draft plan ensures that the WTP CONOPS program will provide requirements and guidelines for developing directives and plans relating to the CONOPS for the WTP facilities, ensuring their safe and efficient operation. The draft plan will be implemented through a CONOPS manual.

The reviewers evaluated each element to ensure the objectives and criteria were consistent with the SRD implementing standard for operations, DOE 5480.19, "Conduct of Operation Requirements for DOE Facilities." The evaluation of the information for each element is summarized below:

1. **Operations Organization and Administration** – The reviewers found the discussion of operations organization and administration to be acceptable for a draft plan. The draft plan identified eight criteria to meet the objective of ensuring that a high level of performance in operations is achieved by effectively implementing and controlling operations activities. Question LAW-PSAR-193 was asked to clarify organization responsibility. In response, BNI committed to modify criterion 1.2.1 in the final plan to state, "Written operating standards and administrative controls are established and approved by management, which include the following:

   (a) The organizational structure is clearly defined.

   (b) Responsibilities and authority for each management, supervisory, professional, and operations position are clearly defined and understood.

   (c) Interfaces with supporting groups are clearly defined and understood."

This commitment was acceptable to the reviewers and should be included in the final CONOPS Plan.

2. **Shift Routines and Operating Practices** – The reviewers found the discussion of shift routines and operating practices to be acceptable for a draft plan. The draft plan identified 13 criteria to meet the objective of establishing and following standards for professional conduct of personnel so that their performance coincides with the expectations of facility management.

3. **Control Area Activities** – The reviewers found the discussion of control area activities to be acceptable for a draft plan. The draft plan identified five criteria to meet the objective of ensuring that such activities are conducted in a manner that achieves safe and reliable facility operation. Question LAW-PSAR-190 was asked to clarify limiting the number of concurrent evolutions being performed at the main control panels so the operators' ability to detect and respond to abnormal conditions was not compromised. In response, BNI committed to add a new criterion to Section 3 of the draft plan to read, "The number of evolutions performed concurrently, which affect control panel indications, is limited as determined by supervision. This is to ensure that the operator's ability to detect and respond to abnormal conditions will not be compromised." This commitment was acceptable to the reviewers and should be included in the final CONOPS Plan.

4. **Communications** – The reviewers found the discussion of communications to be acceptable for a draft plan. The draft plan identified six criteria to meet the objective of ensuring that both normal and emergency communications are highly reliable and accurately transmit information within the facility.

5. **Control of On-Shift Training** – The reviewers found the discussion of control of on-shift training to be acceptable for a draft plan. The draft plan identified seven criteria to meet the objective of ensuring that facility operation is carefully supervised and controlled to avoid mistakes by unqualified personnel and that training activities are conducted to ensure that the time is used effectively.

6. **Investigation of Abnormal Events** – The reviewers found the discussion of investigation of abnormal events to be acceptable for a draft plan. The draft plan identified nine criteria to meet the objective of establishing a thorough review process to ensure that significant aspects of abnormal events are identified, investigated, and resolved. Question LAW-PSAR-191 was asked to clarify why the draft plan did not include a criterion to address event analysis and evaluation as stipulated in SRD Safety Criterion 7.5-2 implementing standard, DOE 5480.19. In response, BNI committed to revise criterion 6.2.1 to read, "Facility guidelines identify specific events, conditions, and 'near miss' situations. The guidelines include instructions for root cause investigation and/or corrective actions as applicable." This commitment was acceptable to the reviewers and should be included in the final CONOPS Plan.

7. **Notifications** – The reviewers found the discussion of notifications to be acceptable for a draft plan. The draft plan identified four criteria to meet the objective of establishing a

program to provide timely notifications to appropriate DOE personnel and other agencies to ensure that the facility is responsive to public health and safety concerns.

8. **Control of Equipment and System Status** – The reviewers found the discussion of control of equipment and system status to be acceptable for a draft plan. The draft plan identified 10 criteria to meet the objective of properly maintaining facility configuration within design requirements by methods that control equipment and system status. Question LAW-PSAR-194 was asked to clarify why none of the criteria addressed controlling the number of degraded conditions outside normal plant configuration that are approved for operation pending their repair (e.g., operator workarounds). In response, BNI committed to modify criterion 8.2.5 of the CONOPS Plan to state, "A system is in place to document equipment deficiencies and define, identify, evaluate, and minimize the existence of operator workarounds."

   Question LAW-PSAR-195 was asked to clarify why controls for overriding interlocks by operators were not discussed. In response, BNI committed to modify criterion 8.2.6 of the CONOPS Plan to state, "A work authorization program is in place to ensure activities (including normal operation, anticipated operational occurrences, maintenance, and testing) on equipment that is important to safety, that affect operations, or that change control indication or alarms, are properly analyzed, documented, and authorized." This revised criterion reflects the logic that the need for operators to override interlocks will be controlled under the work authorization program.

   Question LAW-PSAR-155 was asked to clarify which organization and program was responsible for developing and implementing surveillances to meet TSRs. In response, BNI committed to change criterion 8.2.7 of the CONOPS Plan to state, "ITS equipment and systems will be functionally tested in accordance with surveillance requirements in the Technical Safety Requirements following maintenance and before equipment or systems are considered capable of performing their design functions." These commitments were acceptable to the reviewers and should be included in the final CONOPS Plan.

9. **Lockouts and Tagouts** – The reviewers found the discussion of lockouts and tagouts to be acceptable for a draft plan. The draft plan identified 13 criteria to meet the objective of establishing and implementing a lockout/tagout program to protect personnel and equipment and to help control equipment and system status. Question LAW-PSAR-196 was asked to clarify planned use of the Hanford Site lockout and tagout program, DOE/RL SOD-INST-L&T 001, *Hanford Site Lockout/Tagout Program*. This program is required by contract but conflicts in some cases with the lockout/tagout program described under the draft plan. In response, BNI stated that it will revise its *Nonradiological Worker Safety and Health Plan,* to clarify this difference in lock and tag. The revised plan will distinguish between the construction lockout/tagout program and the commissioning/operations program. The revised plan will identify the implementation of the lockout/tagout program based on the ownership of the system or equipment, as defined in turnover documentation. This commitment was acceptable to the reviewers and should be included in the final CONOPS Plan.

10. **Independent Verification** – The reviewers found the discussion of independent verification to be acceptable for a draft plan. The draft plan identified three criteria to meet the objective of implementing appropriate policies and procedures to ensure correct operation of facility equipment and to aid in controlling equipment and system status.

11. **Logkeeping** – The reviewers found the discussion of logkeeping to be acceptable for a draft plan. The draft plan identified seven criteria to meet the objective of establishing a logkeeping program to provide an accurate history of facility operations and to help control equipment and system status.

12. **Operations Turnover** – The reviewers found the discussion of operations turnover to be acceptable for a draft plan. The draft plan identified six criteria to meet the objective of systematically performing turnovers to provide oncoming personnel with an accurate status of their workstations.

13. **Operations Aspects of Facility Chemistry and Unique Processes** – The reviewers found the discussion of operations aspects of facility chemistry and unique processes to be acceptable for a draft plan. The draft plan identified four criteria to meet the objective of establishing a system to ensure that the operation of interrelated processes is properly monitored and controlled.

14. **Required Reading** – The reviewers found the discussion of required reading to be acceptable for a draft plan. The draft plan identified five criteria to meet the objective of establishing and implementing a required reading program to enhance personnel awareness of important information relative to their job assignments.

15. **Timely Orders to Operators** – The reviewers found the discussion of timely orders to operators to be acceptable for a draft plan. The draft plan identified seven criteria to meet the objective of establishing a program for operations management to communicate, in writing, short-term information and administrative instructions to personnel in a timely fashion.

16. **Operations Procedures** – The reviewers found the discussion of operations procedures to be acceptable for a draft plan. The draft plan identified nine criteria to meet the objective of establishing a procedure program to ensure that operations are conducted in a safe, deliberate, and controlled manner within the design basis of the facility during normal, abnormal, and emergency conditions. Question LAW-PSAR-156 was asked to clarify why neither the draft plan nor Section 12.3 of Volume I of the PSAR addressed the SRD Safety Criterion 7.5-2 implementing standard requirement that procedures affecting safety-related equipment and emergency procedures be reviewed by the facility safety committee, or another appropriate review mechanism. In response, BNI committed to add a criterion to Section 16 that states, "Procedures that affect safety design class and SDS equipment and emergency procedures are reviewed by the facility safety committee or by another appropriate review mechanism." This commitment was acceptable to the reviewers and should be included in the final CONOPS Plan.

Question LAW-PSAR-192 asked to clarify why criterion 16.2.1 of the draft plan included developing and maintaining maintenance procedures under the CONOPS, given that the MIP separately addressed this. In response, BNI committed to revise the cited criterion to remove "maintenance procedures" from its scope. This commitment was acceptable to the reviewers and should be corrected in the final CONOPS Plan.

17. **Operator Aid Posting** – The reviewers found the discussion of operator aid posting to be acceptable for a draft plan. The draft plan identified six criteria to meet the objective of ensuring that operator aids are current, correct, and useful.

18. **Equipment and Pipe Labeling** – The reviewers found the discussion of equipment and pipe labeling to be acceptable for a draft plan. The draft plan identified six criteria to meet the objective of ensuring that facility personnel are able to positively identify the equipment they operate.

19. **Emergency Operating Procedures for Dealing with Responses to Accident Conditions** – The submittal stated that this element was addressed as part of Section 16, "Operations Procedures," of the draft plan. The reviewers agreed that it was adequately discussed as part of Item 16 above.

5.4.3 Conclusions

The reviewers concluded that the draft CONOPS Plan was acceptable for a draft plan. BNI adequately described the primary elements required in a CONOPS Plan. Specific commitments were discussed in the evaluation section that should be included in the final CONOPS Plan for it to be acceptable.

5.5 Training and Qualification Plan (Draft)

The purpose of this review was to determine whether BNI had implemented an acceptable draft Training and Qualification Plan to reasonably ensure that site personnel have the knowledge and skills necessary to design, construct, operate, maintain, modify, and deactivate the facilities in a manner that adequately protects the health and safety of the facility and co-located workers, the public, and the environment. The final plan should adequately describe the training and qualification of managers, supervisors, technical staff, operators, technicians, and maintenance personnel whose level of knowledge is important to the plant's safe operation.

5.5.1 Requirements

The BNI Contract, Section C, Standard 7, Table S7-1, contains the requirements for a draft Training and Qualification Plan, requiring the draft plan to be submitted and approved at the start of construction. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item A.18.e, also requires the draft plan and states that such a plan must be submitted with the CAR. RL/REG-99-05, Section 3.4, "Training and Qualification," provides further guidance on the expected content of

the draft plan. BNI's final Training and Qualification Plan was considered to be acceptable if it met the following criteria:

1. **Organization and Management of the Training System** – BNI demonstrated that it was organized, staffed, and managed to facilitate planning, directing, evaluating, and controlling a systematic training process that fulfilled job-related training needs. BNI demonstrated that it has a graded approach to training based on the results of the site preliminary safety analysis.

2. **Periodic Retraining –** The training program provided for periodic retraining, based on specific criteria. Procedures were described for including operating experience feedback in the training program.

3. **Trainee Selection –** Minimum requirements for selecting trainee candidates were specified for candidates who perform actions relied on to prevent or mitigate accident sequences described in the preliminary safety analysis.

4. **Conduct of Needs/Job Analysis and Identification of Tasks for Training** – The tasks required for competent and safe job performance were identified, documented, and included in the training.

5. **Conduct of Needs/Job Analysis and Identification of Tasks for Training** – Learning objectives that identified training content and defined satisfactory trainee performance were derived from job performance requirements.

6. **Organization of Instruction Using Lesson Plans and Other Training Guides –** Lesson plans and other training guides provided guidance and structure to ensure that training activities were conducted consistently and were based on the required learning objectives derived from specific job performance requirements.

7. **Evaluation of Trainee Mastery of Learning Objectives –** Trainees will be evaluated periodically during training to determine their progress toward mastery of job performance requirements.

8. **Conduct of On-the-Job Training –** On-the-job training, if used for activities required by the preliminary safety analysis, was fully described.

9. **Systematic Evaluation of Training Effectiveness –** A systematic evaluation of training effectiveness and its relation to on-the-job performance will be used to ensure that the training program conveyed the required skills and knowledge and to revise the training, where necessary, based on the performance of trained personnel in the job setting.

10. **Integration of Feedback** – A mechanism will be used to ensure that feedback on unsafe practices, root cause investigations, and other operational human errors related to safety was integrated into continuing qualification training plans or special training sessions.

5.5.2 Evaluation

The reviewers evaluated 24590-WTP-PL-TR-01-002, *Training and Qualification Plan (Draft)*, and found it to be acceptable for a draft Training and Qualification Plan. The final plan, when implemented, will ensure that site personnel have the knowledge and skills necessary to design, construct, operate, maintain, and modify the plant. The evaluation of the information for each evaluation criterion is summarized below:

1. **Organization and Management of the Training System** – The reviewers found the description of organization and management of the training system to be acceptable for a draft plan. BNI committed to establishing a training department to plan, administer, evaluate, and control a systematic process that accomplishes job-related training needs during facility design, construction, and operation. The draft plan was supported by written procedures that described the qualification and requalification process; personnel selection requirements; development, review, approval, and control of training materials; conduct of on-the-job training; and administration of training examinations. Responsibilities of personnel involved in implementing the plan were defined. Formal training was provided for facility operators, technicians, maintenance personnel, emergency response personnel, supervisors and managers, technical instructors, facility staff, and subcontractor employees. A graded SAT, including needs and job analysis, was used to determine training needs and objectives.

2. **Periodic Retraining –** The reviewers found the commitments to the training program to be acceptable for a draft plan. BNI committed to provide refresher training that will comply with periodic training requirements specified in applicable federal and state regulations and to maintain required certifications. Continuing training for operations will be conducted on a two-year cycle. Training will include provision for lessons learned and operating experience feedback, including WTP and industry events. Line managers will be responsible for the content and effective conduct of the training and qualification programs. Training records will be maintained according to Project Document Control procedures.

3. **Trainee Selection –** The reviewers found the description of trainee selection to be acceptable for a draft plan. The plan specified minimum requirements for selecting trainee candidates. BNI committed to hire people who were qualified by education, training, and experience. All managers will be responsible for developing job specific training and minimum education and experience requirements.

4. **Conduct of Needs/Job Analysis and Identification of Tasks for Training** – The reviewers found the commitments to conduct needs/job analysis and to identify training tasks to be acceptable for a draft plan. BNI committed to use the SAT process for analyzing training needs and for designing, developing, conducting, and evaluating training. The SAT process links tasks selected for training to supported procedures and training materials. The training department and WTP facility management work together to create course material and recommend the method of instruction. In the SAT process, systematic evaluations of the training and development program are performed. Training will be modified or developed to respond to changing policy or procedures. The

evaluation of training performed during implementation of SAT supports maintaining WTP training materials current. SAT records document items that may affect the content of training programs and materials, including the job task analysis for positions affected by changes. The SAT process will be conducted on a two-year basis to support the continuing training cycle.

5. **Conduct of Needs/Job Analysis and Identification of Tasks for Training** – The reviewers found the commitments to develop learning objectives as the basis for training to be acceptable for a draft plan. BNI committed to implementing learning objectives developed under the SAT process. Course content was based on course objectives developed by line management and the training department. Training programs will be structured commensurate with specific position needs. The SAT design process requires that learning objectives clearly state the knowledge, skills, and abilities the trainee must demonstrate; the conditions under which required actions will take place; the standards of performance the trainee should achieve when completing the training; and sequencing of the learning objectives based on their relationship to one another.

6. **Organization of Instruction Using Lesson Plans and Other Training Guides –** The reviewers found the submittal's commitment that line managers approve content of training materials, including lesson plans and other training guides, to be acceptable for a draft plan. BNI committed to using lesson plans and on-the-job guides for in-class and on-the-job training. Course content, including lesson plans and on-the-job guides, were based on course objectives developed by line management and the training department. To ensure training activities are consistently and effectively conducted, the training and qualification program will be implemented according to WTP facility procedures. Qualification of personnel requires that the trainees demonstrate skills on the job and during examination.

7. **Evaluation of Trainee Mastery of Learning Objectives –** The reviewers found the submittal's commitment to evaluate trainees' mastery of learning objectives to be acceptable for a draft plan. BNI committed to the SAT, which included trainee evaluation. Tests or exercises will be used to demonstrate mastery of skills and knowledge presented in the classroom. An on-the-job item will not be completed until the trainee has demonstrated mastery of the item.

8. **Conduct of On-the-Job Training –** The reviewers found the commitments to on-the-job training to be acceptable for a draft plan. BNI committed to conducting on-the-job training using organized performance-based training materials developed under the SAT development phase. On-the-job training cards were derived from task lists that will be updated every two years. Trainee mastery will be evaluated by qualified on-the-job instructors observing trainee demonstration of skills and knowledge during actual job performance and by trainees demonstrating skills and knowledge presented in the classroom. The SAT design phase identified the training environment, including on-the-job training demonstration, and provided for situations where the actual task cannot be performed and therefore was walked-through. In this case, the conditions of task performance, references, tools, and equipment reflecting the actual task to the extent possible will be identified in the SAT design phase.

9. **Systematic Evaluation of Training Effectiveness –** The reviewers found the commitments to systematic evaluation of training effectiveness to be acceptable for a draft plan. The SAT process incorporated a systematic evaluation of training effectiveness on a two-year basis. Qualified individuals will evaluate the training. Feedback from line management on personnel performance, trainee performance during training, and student course critiques will be included in evaluating training effectiveness. Changes will be monitored for their impact on training programs. Training will be modified or developed on a two-year interval to respond to sources of feedback, changing requirements, and changing policy or procedures.

10. **Integration of Feedback** – The reviewers found the commitment to integrate feedback into training to be acceptable for a draft plan. BNI committed to ensure that feedback on unsafe practices, root cause investigations, and other operational human errors related to safety will be integrated into continuing qualification training plans or special training sessions. The training department and line management will respond to feedback from the CM system, quality program, and self-assessment activities to ensure personnel involved in the WTP achieve and maintain the capabilities required to perform their assigned tasks safely. Performance-based training will be based in part on feedback from operational experience, lessons learned, and industry experience and events. Training will be modified or developed in a timely manner to respond to sources of feedback. Continuing training will also include training in applicable industry events.

5.5.3 Conclusions

The reviewers concluded that the draft Training and Qualification Plan was acceptable for a final plan. The draft plan committed to obtaining and maintaining a well-qualified staff and to having a performance-based training process based on the SAT. Implementation of the described training plan as a final plan should result in staff who are qualified and competent to design, construct, and operate the facility safely.

5.6 Maintenance Implementation Plan (Draft)

The purpose of this review was to determine whether BNI had an acceptable draft MIP for ITS SSCs during the construction, preoperational, and operational phases to ensure the facility's continued availability and reliability. The level of detail in the draft plan should be appropriate for the preliminary design.

5.6.1 Requirements

The Contract, Section C, Standard 7, Table S7-1, contains the requirements for a MIP, stating that a draft MIP be submitted and approved at the start of construction. RL/REG-99-05, Section 3.2.3.2, "Regulatory and Contractual Requirements," provides further guidance on the draft MIP, stating that the draft plan should address each of 17 areas of the maintenance program. BNI's final MIP was acceptable if it met the following criteria:

1. **Organization and Administration –** The organization and administration of maintenance ensure that maintenance is effectively implemented and controlled. Maintenance activities are effectively implemented and controlled primarily by establishing written policies, procedures, and standards for maintenance; periodically observing and assessing performance; and holding personnel accountable for their performance.

2. **Training and Qualification of Maintenance Personnel –** BNI described the program for providing maintenance training and qualification for personnel.

3. **Maintenance Facilities, Equipment, and Tools –** BNI described the program for providing maintenance facilities, equipment, and tools and considered issues such as industrial safety, location, access, communications, environmental controls, radiological controls, power sources, and the type of activities to be performed.

4. **Types of Maintenance –** BNI described the four types of maintenance to be performed (i.e., surveillance/testing, corrective, preventive, and predictive) and discussed the equipment and methodology to be used.

5. **Maintenance Procedures and Other Work Related Documents –** BNI described the maintenance procedures and other work-related documents associated with the maintenance program, such as the maintenance procedure concepts, including preparing, verifying, validating, approving, controlling, using, and periodically revising the procedures so they are technically accurate, complete, and up to date.

6. **Planning, Scheduling, and Coordination of Maintenance –** BNI described the planning, scheduling, and coordinating functions of the maintenance program used to ensure that maintenance is accomplished in a timely manner and that equipment availability is increased.

7. **Control of Maintenance Activities –** BNI described the control of maintenance activities including how management involvement ensures that maintenance activities are controlled and that maintenance practices are effective in maintaining safe and reliable facility operation. This control extends to all facility, other contractor, and subcontractor personnel involved in maintenance activities.

8. **Post-Maintenance Testing –** BNI described post-maintenance testing concepts to the degree necessary to verify that components will fulfill their design function when returned to service after maintenance. An effective post-maintenance testing program applies to all ITS maintenance activities.

9. **Procurement of Parts, Materials, and Services –** BNI described the procurement of parts, materials, and services portion of the maintenance program. Effective procurement of parts, materials, and services, in conjunction with the QAM, provides the proper parts and material in good condition as necessary to maintain design requirements for maintenance activities during normal facility operation periods and to support both forced and planned outages.

10. **Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance –** BNI described how material is received, inspected, handled, stored, retrieved, and issued. Effective conduct of these activities, in conjunction with the QAM, verify that the items delivered agree with the approved purchase documentation, are packaged according to purchase order specification, have necessary product control requirements furnished by the vendor, and appear to be in good condition.

11. **Control and Calibration of Measuring and Test Equipment –** BNI described the control and calibration of measuring and test equipment. Effective control and calibration of measurement and test equipment, in conjunction with the QAM, ensure the accurate performance of facility instrumentation and equipment for testing, calibration, and repairs.

12. **Maintenance Tools and Equipment Control –** BNI described the maintenance program for tools and equipment control, which include items such as storage and issuance, maintenance, and the use of special tools and equipment.

13. **Facility Condition Inspection –** BNI described the portion of the maintenance program that documents facility condition inspections, including an effective maintenance inspection program, which considers the effects of declining plant conditions and aging.

14. **Management Involvement with Facility Operations –** BNI described the involvement of maintenance management with facility operations, including elements such as setting performance indicators, goals, and objectives; feedback; and program reviews. Management involvement conveys that facility management will be involved to the point of being technically informed and personally familiar with conditions at the operating facility, ensuring operating safety. Facility management periodically reviews the intended program to ensure that objectives are being met and upgrades are performed as needed to ensure safety is being maintained.

15. **Maintenance History and Trending –** BNI described the maintenance history and trending portion of the maintenance program, including items such as program development, data collection, and program utilization. BNI's maintenance history and trending program provide for collecting data, storing historical information for maintenance planning, and supporting maintenance and performance trending of facility systems and components.

16. **Analysis of Maintenance-Related Problems –** BNI described the program for analyzing the maintenance-related problems originating from unplanned occurrences that impact safety or reliability or that are recurring, indicating that corrective actions have not been effective in solving the root cause(s) of the problem.

17. **Modification Work –** BNI described the elements of the modification work that provide for safe installation of temporary modifications within the confines of the maintenance program. This generally involves an evaluation program for impact (such as an USQ determination) on the authorization basis as well as other programmatic interfaces within operations, QA, and engineering. This element should describe the difference between

modifications under the maintenance program and permanent modifications performed by other organizations.

5.6.2 Evaluation

The reviewers evaluated 24590-WTP-PL-OP-01-004, *WTP Maintenance Implementation Plan*, (*Draft)*, and found it to be acceptable for a draft plan. However, changes noted in the evaluation should be included in the final plan. Where applicable, elements of the MIP were consistent with other authorization basis documents and requirements, including the PSAR and the QAM. The MIP contained 18 elements, each with a stated objective and a set of criteria designed to accomplish the objective. The first 17 elements aligned with those required by SRD Safety Criterion 7.6-4, which requires that the maintenance program address each one. BNI added an additional element to cover seasonal facility preservation. By addressing each element required by SRD Safety Criterion 7.6-4, the MIP will ensure that the WTP maintenance program will preserve, predict, and restore the availability, operability, and reliability of ITS SSCs. The MIP will be implemented through maintenance implementing procedures or a manual.

The reviewers evaluated each element to ensure that the objectives and criteria were consistent with the SRD implementing standard for maintenance, DOE O 433.1, *Maintenance Management Program for DOE Nuclear Facilities*. The evaluation of the information for each of the 17 elements listed above and one additional element is summarized below:

1. **Organization and Administration** – The reviewers found the discussion of organization and administration to be acceptable for a draft plan. The draft plan identified 15 criteria to meet the objective of ensuring that a high level of performance is achieved by effectively implementing and controlling maintenance activities. Question LAW-PSAR-182 was asked to clarify how criterion 1.2.9 of the draft plan aligned with the QAM in that the criterion appeared to require root cause evaluations for problems identified through assessments without regard to their significance (which is not consistent with QAM policy Q-16.1). In response, BNI committed to revise criterion 1.2.9 to read, "Problems that are identified by assessments are analyzed to properly implement effective corrective actions," removing any reference to determining the root causes for the problems. This commitment was acceptable to the reviewers and should be included in the final MIP.

2. **Training and Qualification of Maintenance Personnel** – The reviewers found the discussion of training and qualification of maintenance personnel to be acceptable for a draft plan. The draft plan identified 17 criteria to meet the objective of developing and maintaining knowledge and skills required by maintenance personnel to perform maintenance activities safely and effectively using ALARA concepts and according to the QAM. Question LAW-PSAR-174 was asked to clarify how the criteria of element 2 of the draft plan addressed the QAM requirement in Policy Q-02.2 of a continuing training program to maintain and enhance the knowledge and skills of personnel commensurate with specific position needs (in this case, maintenance personnel who maintain ITS SSCs). In response, BNI stated it intends to comply with the Contract and qualify maintenance personnel to support hot commissioning. BNI will use the

implementing standard, DOE O 433.1, to establish a maintenance training and qualification program for hot commissioning that will include, as appropriate, on-the-job training on new equipment and processes, required reading for new and modified equipment and processes, lessons learned, and other routine updates associated with conduct of maintenance on the WTP. This commitment was acceptable to the reviewers and should be included in the final MIP.

3. **Maintenance Facilities, Equipment, and Tools** – The reviewers found the discussion of maintenance facilities, equipment, and tools to be acceptable for a draft plan. The draft plan identified 18 criteria to meet the objective of supporting facility maintenance and maintenance training functions.

4. **Types of Maintenance** – This section of the draft plan included an overall objective and several sub-objectives. The sub-objectives aligned with the types of maintenance that will be included in the WTP maintenance program and addressed conduct of maintenance and modification work. The types of maintenance included preventive, predictive, and corrective. Surveillance/testing maintenance was addressed under criterion 4.3.16 of the MIP, with additional details provided in Section 10.4 of the PSAR. The criteria identified for meeting the overall and sub-objectives were acceptable for a draft plan, with the following clarifications:

   (a) Question LAW-PSAR-171 was asked to clarify how the maintenance program will be tailored for different classes of SSCs. In response, BNI committed to add to Section 4, "Types of Maintenance," a new criterion that would provide this description. This commitment was acceptable to the reviewers and should be included in the final MIP.

   (b) Question LAW-PSAR-172 was asked to clarify how the draft plan addressed the requirements of SRD Safety Criterion 7.6-3, elements (1) and (9) to identify the ITS SSCs and to establish quantitative reliability target values for the SSCs. In response, BNI committed to add a new criterion to Section 4 of the MIP that reads, "The maintenance program will implement the requirements of the TSRs and preventive maintenance as prescribed by engineering in performing work on ITS SSCs comprising the facility." BNI also will change the plan to state, "Engineering will evaluate the ITS SSCs and the safety analysis to determine quantitative reliability targets and incorporate these into TSRs; and maintenance will ensure that they are included in the preventive maintenance program." This commitment was acceptable to the reviewers and should be included in the final MIP.

   (c) Question LAW-PSAR-179 was asked to clarify why criterion 4.5.2 in the draft plan stated that the selection process used to place items in the predictive maintenance program would comply with the QAM. In response, BNI stated that the selection process was not governed by the QAM, but by the conduct of maintenance manual, and committed to revise criterion 4.5.2 accordingly. This commitment was acceptable to the reviewers and should be included in the final MIP.

(d) Question LAW-PSAR-188 was asked to clarify why the MIP did not include a criterion that requires controls for deferring preventive maintenance. In response, BNI committed to add a new criterion to Section 4 of the MIP to state, "The maintenance program shall have a process to control deferred preventive maintenance." This commitment was acceptable to the reviewers and should be included in the final MIP.

(e) Question LAW-PSAR-177 was asked to clarify why the MIP did not include a criterion that addressed management's responsibility to ensure that plant configuration was maintained during and after maintenance to ensure that the facility conformed to design and authorization basis requirements. In response, BNI stated that the conduct of maintenance manual will include processes that control configuration of the plant during and after maintenance activities. In addition, CM for the maintenance organization is controlled through 24590-WTP-GPP-CMNT-001, *Commissioning and Training Work Control*. This commitment was acceptable to the reviewers and should be included in the final MIP.

5. **Maintenance Procedures and Other Work-Related Documents** – The reviewers found the discussion of maintenance procedures and other work-related documents to be acceptable for a draft plan. The draft plan identified 12 criteria to meet the objective of ensuring that maintenance is performed safely and efficiently on ITS SSCs.

6. **Planning, Scheduling, and Coordination of Maintenance** – The reviewers found the discussion of planning, scheduling, and coordination of maintenance to be acceptable for a draft plan. The draft plan identified 17 criteria to meet the objective of making certain that maintenance is accomplished in a timely manner, enhances worker safety, improves maintenance efficiency, reduces radiation exposure, and increases equipment availability.

7. **Control of Maintenance Activities** – The reviewers found the discussion of control of maintenance activities to be acceptable for a draft plan. The draft plan identified 14 criteria to meet the objective of involving management in controlling maintenance activities to ensure that they are effective in maintaining safe and reliable facility operations. Question LAW-PSAR-187 was asked to clarify why the draft plan did not include a criterion to control troubleshooting. In response, BNI committed to add a criterion to Section 7 that reads, "Troubleshooting activities are controlled by applicable work documents to prevent unplanned repairs and unauthorized modifications." This commitment was acceptable to the reviewers and should be included in the final MIP.

8. **Post-maintenance Testing** – The reviewers found the discussion of post-maintenance testing to be acceptable for a draft plan. The draft plan identified 10 criteria to meet the objective of determining whether maintenance was performed properly and whether equipment operates correctly and performs its desired function when returned to service after maintenance activities.

9. **Procurement of Parts, Materials, and Services** – The reviewers found the discussion of procurement of parts, materials, and services to be acceptable for a draft plan. The draft

plan identified three criteria to meet the objective of ensuring that proper parts, materials, and services required for maintenance activities are available when required.

10. **Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance** – The reviewers found the discussion of material receipt, inspection, handling, storage, retrieval, and issuance to be acceptable for a draft plan. The draft plan identified 15 criteria to meet the objective of covering these activities by effectively implemented policies and procedures from the time the items are received until they are installed in the facility.

11. **Control and Calibration of Measuring and Test Equipment** – The reviewers found the discussion of control and calibration of measuring and test equipment to be acceptable for a draft plan. The draft plan identified 12 criteria to meet the objective of controlling and calibrating measuring and test equipment consistent with QAM requirements and to ensure the accurate performance of facility instrumentation and equipment for testing, calibration, and repair. Question LAW-PSAR-185 was asked to clarify the meaning of related text in PSAR Volume I, Section 10.5.13, which stated, "The WTP M&TE program will include the following elements ... " one of which was, "Procedures governing costly evaluation of equipment tested with defective or suspected defective M&TE." The reviewers questioned use of cost as a decision-making criterion for evaluating equipment tested with defective measuring and test equipment. In response, BNI committed to revising the cited element to remove the word "costly." This commitment was acceptable to the reviewers and should be included in the final MIP.

12. **Maintenance Tools and Equipment Control** – The reviewers found the discussion of maintenance tools and equipment control to be acceptable for a draft plan. The draft plan identified five criteria to meet the objective of making available methods to store, issue, and maintain an adequate and readily available supply of tools and equipment and to develop special tools and equipment needed in the maintenance program.

13. **Facility Condition Inspection** – The reviewers found the discussion of facility condition inspection to be acceptable for a draft plan. The draft plan identified one criterion to meet the objective of ensuring that management periodically inspects safety equipment and facilities to ensure excellent facility condition and housekeeping. The criterion referred to information in Section 7 and subelement 4.11, "Modification Work," of the draft plan as addressing this element. Question LAW-PSAR-173 was asked to clarify how the cited sections addressed the objective of periodic management inspections of the safety equipment and facilities to ensure excellent facility conditions. In response, BNI committed to revise criterion 13.2 to read, "Information in this section is covered in Section 4, 'Types of Maintenance'; Section 7, 'Control of Maintenance Activities'; and Section 14, 'Management Involvement.'" PSAR Section 10.5.9 provided additional details about these inspections and their implementation. In particular, Section 10.5.9 stated, "Maintenance and operations personnel (including management and supervision) will perform facility condition inspections. The program will include personnel training, preplanned inspection checklists, and tracking of inspection findings." This commitment was acceptable to the reviewers and should be included in the final MIP.

Question LAW-PSAR-181 was asked to clarify why the draft plan did not address the maintenance organization's responsibility for implementing the engineering programs designed to monitor ITS SSCs for mechanical degradation to ensure that the MIP criterion met the objective of element 13 of SRD Safety Criterion 7.6-4 (i.e., to identify and address aging effects). In response, BNI committed to add a new criterion to Section 13 of the MIP that reads, "Mechanical degradation inspections as prescribed by engineering evaluations will be implemented." This commitment was acceptable to the reviewers and should be included in the final MIP.

14. **Management Involvement** – The reviewers found the discussion of management involvement to be acceptable for a draft plan. The draft plan identified 12 criteria to meet the objective of ensuring the safety of DOE facility operations by keeping managers technically informed and personally familiar with conditions at the operating facilities.

15. **Maintenance History** – The reviewers found the discussion of maintenance history to be acceptable for a draft plan. The draft plan identified four criteria to meet the objective of maintaining maintenance history and trending programs to provide historical information for maintenance planning.

16. **Analysis of Maintenance-Related Problems** – The reviewers found the discussion of analysis of maintenance-related problems to be acceptable for a draft plan. The draft plan identified one criterion to meet the objective of using systematic analysis to determine and correct root causes of unplanned occurrences related to maintenance. Question LAW-PSAR-180 was asked to clarify what criteria would be used for selecting events/occurrences on which evaluations would be performed and for performing the evaluations. In response, BNI committed to revise criterion 16.2.1 to read, "Unplanned failures and outages will be investigated according to the project administrative procedure on investigation of abnormal events. This will ensure collection of necessary information so the root cause can be determined for long long-term correction." Question LAW-PSAR-182 was asked to clarify how the draft plan (in Sections 1 and 16) aligned with the QAM in that the criterion in Section 1 appeared to require root cause evaluations for problems identified through assessments, without regard to their significance, which is not consistent with QAM Policy Q-16.1. In addition, Section 16 in the draft plan did not address the threshold for requiring initiation of root cause determinations. In response, BNI committed to add a new criterion to Section 16 that reads, "Management will determine the need for root cause analysis based on the project's QA procedure, 24590-WTP-GPP-QA-201A, 'Corrective Actions.'" This commitment was acceptable to the reviewers and should be included in the final MIP.

17. **Modification Work** – The reviewers found the discussion of modification work to be acceptable for a draft plan. One criterion, which cited subelement 4.11, "Modification Work," in the draft plan as covering this element, acceptably addressed the objective of ensuring that modification work is accomplished under the same basic administrative controls as those applied to facility maintenance activities to avoid increases in risk to facility equipment, environment, or personnel.

18. **Seasonal Facility Preservation** – The reviewers found the discussion of seasonal facility preservation to be acceptable for a draft plan. One criterion, which cited subelement 4.3, "Preventive Maintenance," as covering this objective, acceptably addressed the objective of ensuring that seasonal facility preservation includes developing and implementing a plan to address external weather/environmental conditions for safely operating and preserving the WTP. The reviewers noted that BNI was conservative in stipulating this as a separate element in the MIP because it was beyond the scope of elements required to be addressed by the applicable SRD safety criteria.

5.6.3 Conclusions

The reviewers concluded that the draft MIP was acceptable as a draft plan. The draft MIP described a maintenance program appropriately tailored and sufficient to preserve, predict, and restore the availability, operability, and reliability of ITS SSCs. BNI commitments to changes identified in the evaluation above should be included in the final plan for it to be acceptable.

5.7 Occurrence Reporting Plan (Draft)

The purpose of this review was to determine whether BNI had an acceptable draft Occurrence Reporting Plan that adequately addressed occurrence reporting related to radiological, nuclear, and process safety during hot commissioning of the WTP.

5.7.1 Requirements

Table S7-1 of the Contract and DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item A.18.f, required submittal of a draft Occurrence Reporting Plan that addressed the requirements for incident reporting and investigation as related to the WTP's hot commissioning and operations phases. Section C, Standard 1, of the BNI Contract further specifies that occurrence reporting will adhere to DOE M 232.1-1A.

Section 3.7.3.2, "Regulatory and Contractual Requirements," of RL/REG-99-05 provides guidance on occurrence reporting, stating that (1) the program should address reporting of noncompliances with DOE nuclear safety requirements to ORP's Price Anderson Amendment Act Coordinator and DOE's Office of Price-Anderson Enforcement; (2) the incident reporting program, including identifying, tracking, and implementing corrective actions taken in response to incidents, should be consistent with the QAM (and subpart A of 10 CFR 830); (3) the program should meet requirements for reporting and incident investigation as described in the SRD, Section 7.7, "Reporting and Incident Investigation"; and (4) the program should address discovery of programmatic safety issues as well as ITS events.

5.7.2 Evaluation

The reviewers evaluated 24590-WTP-PL-OP-01-006, *Occurrence Reporting Plan for Commissioning*, and found it to be acceptable. The draft plan established a system for identifying, categorizing, and reporting occurrences in a timely manner according to DOE M 232.1-1A. The draft plan was developed to categorize and report occurrences during the WTP's commissioning and operational phase and will be implemented by procedures. The draft plan stated that the current occurrence reporting program, referring to the limited construction occurrence reporting program, will be expanded to include commissioning and operational activities and will be turned over to a commissioning organization before the start of cold commissioning. The current program included use of occurrence reporting procedure, 24590-WTP-GPP-SIND-001-0.

Section 3.3 of the draft plan stated that reportable events were not limited to operational events; events such as programmatic safety issues or ITS events could also be reportable. Section 3.7 of the draft plan stated that events will be evaluated to determine applicability of the Price Anderson Act Administrator, and Section 3.6 of the draft plan stated that events classified as off-normal occurrences would be reported to the Price Anderson Act Administrator Coordinator. Section 3.7 also stated that a graded approach will be used to determine the level of effort required to determine the cause of an occurrence and to develop corrective action to prevent recurrence. Section 3.7 also stated that the WTP Occurrence Reporting procedure will be written in accordance with the approved Project Procedure Standard. Section 3.8 of the draft plan stated corrective actions identified as a result of the occurrence would be placed in the database to ensure they are tracked and implemented, according to the QAM, Policy Q-16.1 on corrective actions, and Subpart A of 10 CFR 830. Finally, the draft plan was found to be consistent with the time requirements of SRD Safety Criterion 7.7-6.

The reviewers also evaluated the occurrence reporting process as described in Section 17.4.7 of Volume I of the PSAR and found it to be acceptable, as noted in Section 5.1.2 of this SER. The reviewers determined the draft Occurrence Reporting Plan acceptably addressed the following: (1) the types of incidents that could be encountered during construction; (2) criteria for reporting incidents and methodology to notify appropriate regulatory authorities; (3) timeliness criteria for reporting incidents; (4) how incident reports will be initiated, reviewed, and approved; (5) how incidents will be investigated; (6) how incident causes will be determined and appropriate corrective actions identified; and (7) BNI responsibility assignments for incident reporting and investigation.

5.7.3 Conclusion

The reviewers concluded that the draft Occurrence Reporting Plan was acceptable as a draft plan. The draft pan will be acceptable as a final plan once the commitment to expand the current reporting program to include commissioning and operational activities, as noted in the Scope of the plan, and once the WTP Occurrence Reporting procedure is written in accordance with the approved Project Procedure Standard (Section 3.7 of the draft plan). The Construction Occurrence Reporting procedure and Section 17.4.7 of Volume I of the PSAR were consistent

with the draft Occurrence Reporting Plan, and all three documents met the requirements of an acceptable draft occurrence reporting program.

5.8 Deactivation Plan (Draft)

The purpose of this review was to determine whether BNI had an acceptable draft Deactivation Plan describing its plans for eventual deactivation of the WTP.

5.8.1 Requirements

The Contract, Section C, Standard 7, Table S7-1, contains the requirements for a draft Deactivation Plan, requiring a draft plan be submitted and approved at the start of construction. DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," Item 9, also requires that a draft Deactivation Plan is acceptable before authorization for full facility construction.

RL/REG-99-05, Section 11.3.3, "Regulatory Acceptance Criteria," provides further guidance on the draft Deactivation Plan, stating that the deactivation plan should have details on how the following activities will be accomplished to deactivate the facility: (1) verifying that the facility deactivation endpoint has been completed; (2) documenting the regulatory status, conditions, and inventories of remaining radioactive and hazardous materials and health and safety requirements; (3) modifying the facilities, structures, support systems, and surveillance systems to confine and monitor the remaining contamination, radiation, and other potential hazards; (4) posting and securing the facility; (5) removing packaged radiological and chemical materials; and (6) confirming that security systems and procedures are adequate and in place to prevent unauthorized entry.

5.8.2 Evaluation

The reviewers evaluated 24590-WTP-PL-OP-01-007, *Deactivation Plan*, and found it to be acceptable as a draft plan. The draft plan described a deactivation strategy to achieve a safe, stable, and passive facility consistent with the requirements expressed in SRD Safety Criterion 8.0-1; the SRD, Appendix F, "Ad Hoc Implementation Standard for Deactivation and Decommissioning Planning"; and DOE O 430.1A.

DOE has not yet determined if it will place the WTP facilities into a long- or short-term shutdown and maintenance phase, complete the RCRA of 1976 closure, or begin immediate D&D following cessation of operations. For the draft Deactivation Plan, BNI assumed that the WTP facilities would be placed in a long-term shutdown and maintenance mode following deactivation.

The draft plan established a project management approach that included facility deactivation endpoint criteria and methodology to establish individual endpoints for specific plant areas, structures, systems, equipment, and documentation. The draft plan described how radioactive, hazardous, and chemical materials would be removed and any residual material characterized

and documented. Chapter 10 of the draft plan explained how these endpoints would be verified and documented.

Section 1.2 of Appendix A of the draft plan described how the regulatory status, final conditions, and inventories of remaining radioactive/hazardous/chemical materials would be documented. It also described how the procedures, plans, and drawings that describe modifications to the facilities, structures, systems, and surveillance systems to confine and monitor remaining contamination would be documented.

Section 1.6.1 of Appendix A of the draft plan stated in part, "However, if unforeseen incidents occur that result in subsurface contamination, only 6 inches will be remediated and barriers installed if necessary." Question LAW-PSAR-132 was asked to clarify removal of subsurface contamination. In response, BNI stated that it would revise the statement to read, "… if unforeseen incidents occur that result in subsurface contamination, the contamination will be removed unless DOE agrees that it is consistent with the proposed endpoint criteria and the extent of remaining contamination is controlled in accordance with the Radiation Protection Program and documented." This commitment was acceptable to the reviewers and should be included in the final Deactivation Plan. Also in the same response, BNI committed to include, in Section 1.2.3 of Appendix A, records related to the previous release of contaminated material made pursuant to 10 CFR 835.703, "Other Monitoring Records," and those actions taken to maintain dose ALARA pursuant to 10 CFR 835.704b, "Administrative Records." This commitment was acceptable to the reviewers and should be included in the final Deactivation Plan.

The draft plan committed to implement the posting and control requirements specified in 10 CFR 835. The plan described how the facilities would be secured to prevent unauthorized entry. It also stated, "All critical monitoring and operating equipment signals from the unoccupied facility will be relayed to a staffed control center for action." In addition, implementation of the "Master Safeguards and Security Agreement" mentioned in the draft plan will ensure that security systems and procedures are adequate and in place to prevent unauthorized entry.

5.8.3 Conclusions

The reviewers concluded that the draft Deactivation Plan was acceptable as a draft plan. The draft plan makes clear the objectives to reduce exposure and minimize waste during and following deactivation. To be acceptable, the final Deactivation Plan should incorporate the commitments described above in the OAR.

5.9 Environmental Radiological Protection Program (Draft)

The purpose of this review was to determine whether the submittal adequately described an acceptable draft ERPP and to describe any changes to the draft ERPP that should be made to ensure that the final ERPP is acceptable for the OAR.

5.9.1 Requirements

The Contract, Section C, Standard 7, Table S7-1, contains the requirements for a draft ERPP and requires a draft ERPP be submitted with the CAR. DOE/RL-96-0003, Section 4.2.2, "Contractor Input," Item A.18.h, similarly requires a draft ERPP be submitted with the CAR.

RL/REG-99-05, Section 10.2.3, "Draft ERPP," provides further guidance on the draft ERPP and states that review of the draft ERPP should include the following four main areas of review: (1) radiation protection from effluents for the public and the environment, (2) effluent control and monitoring, (3) waste management, and (4) environmental monitoring.

The reviewers evaluated the draft ERPP based on the safety criteria in Sections 5.3 and 5.4 of the SRD and by the review criteria in RL/REG-99-05 for the following areas:

1. **Radiation Protection from Effluents for the Public and the Environment**

   (a) Conformance with requirements
   (b) ALARA goals
   (c) Engineering and administrative controls
   (d) Contamination control
   (e) Draft ERPP documentation.

2. **Effluent Control and Monitoring**

   (a) Discharge locations
   (b) Effluent mitigation measures
   (c) Physical and chemical characteristics of effluents
   (d) Known or expected concentrations of effluents
   (e) Sample identification and frequency
   (f) Sample collection and analysis
   (g) Recording and reporting of results
   (h) Dose assessment
   (i) Action levels and actions
   (j) Leak detection for tanks and ancillary equipment
   (k) Local, state, and federal discharge permits.

3. **Waste Management**

   (a) Waste minimization
   (b) Handling and storage
   (c) Disposal.

4. **Environmental Monitoring**

   (a) Background and baseline
   (b) Sample identification and frequency
   (c) Sample collection and analysis

(d) Recording and reporting of results
(e) Dose assessment
(f) Action levels and actions
(g) Biosphere modeling
(h) Meteorological data acquisition.

While not all of the topics must be addressed in complete detail in the draft ERPP, the topics should be addressed and described to ensure their inclusion in the final ERPP developed for operations.

5.9.2 Evaluation

The reviewers evaluated the draft ERPP based on whether it identified and described a program that provided physical design features and administrative controls to ensure adequate (1) radiation protection from effluents for the public and the environment, (2) effluent control and monitoring, (3) waste management, and (4) environmental monitoring. The reviewers evaluated 24590-WTP-PL-ENV-01-006, as well as BNI responses to questions about the draft ERPP, and found the ERPP to be acceptable for a draft program. Several commitments provided in response to reviewer questions will be included in the final ERPP. The reviewers found the draft ERPP to be consistent with BNI's radiation protection program; PSAR Volume I, Chapter 9; and other environmental submittals.

The draft ERPP referenced numerous documents as having implemented SRD safety criteria, but the reviewers could not always determine how this implementation had been accomplished. As part of the response to Question LAW-PSAR-123 concerning how SRD Safety Criteria 5.3-1 and 5.4-10 would be met, BNI submitted a cross-reference review matrix, "Environmental Protection/Draft ERPP Safety Criteria Crosswalk,"[157] which identified where BNI had addressed the SRD safety criteria in its documentation.

Table 4 summarizes the information from the matrix to show where BNI identified interfaces between SRD Safety Criteria 5.3 and 5.4 and permits to be issued by the U.S. Environmental Protection Agency (EPA), the Washington State Department of Health (WDOH), and Ecology. The WDOH and Ecology have agreed to a phased approach for granting these permits for BNI.

Evaluation of the draft ERPP, the review matrix, and responses to questions developed by the reviewers is provided below for the individual sections of the ERPP:

1. **Radiation Protection from Effluents for the Public and the Environment** – The evaluation of the information for each review area is summarized below:

   (a) **Conformance with Requirements** – The reviewers found the description of conformance with requirements to be acceptable for a draft program. Section 5 of

[157] CCN: 033561, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Closeout Comment/Responses on Low Activity Waste, High Level Waste, and Balance of Facilities Construction Authorization Requests," dated May 31, 2002.

Table 4. SRD Criteria 5.3 and 5.4 Interfaces with Permits

SRD Safety Criteria	Permit(s)[(a)]
5.3-1(5)	BARCT[158]
5.3-1(6)(i) and (ii)	BARCT and Rad NOC[159]
5.3-1(6)	ST 4502[160]
5.3-2	BARCT
5.3-4	BARCT, Rad NOC, and DWPA
5.3-5	BARCT
5.3-6	BARCT
5.3-7	BARCT
5.4-1	BARCT, Rad NOC, and DWPA
5.4-3	BARCT, Rad NOC, and DWPA
5.4-4	BARCT, Rad NOC, and DWPA
5.4-5	BARCT, Rad NOC, and DWPA
5.4-7	BARCT, Rad NOC, and DWPA
5.4-8	BARCT, Rad NOC, and DWPA
(a) BARCT = Best Available Radionuclide Control Technology; Rad NOC = Radioactive Air Emissions Notice of Construction Permit Application; and DWPA = Dangerous Waste Permit Application.	

the draft ERPP committed to conform to the dose standards in SRD Safety Criteria 2.0-1, 2.0-2, and 2.0-3.

(b) **ALARA Goals** – The reviewers found the description of the ALARA goals to be acceptable for a draft program. Section 6 of the draft ERPP described ALARA goals that were sufficient to demonstrate that effluents and the release of radioactive material will be managed and controlled such that the impacts on the environment and exposures to the public are kept ALARA during operations. However, Section 6 did not describe how effluents will be managed and controlled as a result of accidents, so Question LAW-PSAR-125 was asked to clarify this. In response, BNI stated that specific emergency situations will be identified as the facility design progresses and plant operations become more identifiable. BNI committed to adding a description of project emergency activities to Section 5.2 of the final ERPP. \

(c) **Engineering and Administrative Controls** – The reviewers found the description of the engineering and administrative controls to be acceptable for a draft program. The draft ERPP identified acceptable engineering controls to monitor and maintain control over radioactive materials in gaseous and liquid effluents produced during normal operations and anticipated operational occurrences. Sections 7, 8, and 9 of the draft ERPP referenced documents that described engineering controls to reasonably ensure that dose standards will not

[158] 24590-WTP-RPT-ENV-01-004, *Best Available Radionuclide Control Technology Analysis for the WTP*.
[159] 24590-WTP-RPT-ENV-01-008.
[160] *State of Washington Discharge Permit No. ST 4502*. State of Washington Department of Ecology – This is a site wide permit that will be modified to include the WTP.

be exceeded and that effluents, environmental impacts, and doses to the public will be kept ALARA. The draft ERPP proposed acceptable administrative controls for situations where engineering controls were shown not to be ALARA by an appropriate and supportive cost-benefit analysis. The draft ERPP referenced several documents as implementing engineering controls for the project, including the BARCT analysis and the Rad NOC.

Question LAW-PSAR-124 was asked to clarify how tank or ancillary equipment leakage and detection, monitoring, and removal systems to prevent environmental releases of leaked wastes will be addressed. In response, BNI committed to adding text to the final ERPP to identify facility tank and ancillary equipment and to update the information as the project development and design evolves. Question LAW-PSAR-126 was asked to clarify what the process was to ensure that aspects of the environmental radiological protection system for air emissions were integrated and to ensure proper function when pieces of nonradioactive and radioactive emissions controls were integrated. In response, BNI committed to describe the environmental requirements and design integration process in the final ERPP. These commitments were acceptable to the reviewers and should be included in the final ERPP.

(d) **Contamination Control** – The reviewers found the description of contamination control to be acceptable for a draft program. Question LAW-PSAR-213 was asked to clarify environmental radiological contamination controls. In response, BNI identified which controls would be implemented for the facility and surrounding environment during design, construction, and pre-operational testing. BNI stated that Section 4.2, "Radioactive Contamination Detected during Construction," of the LCAR would be used and stated that procedures would address construction site response to off-normal radiological conditions. Question LAW-PSAR-128 was asked to clarify the program attributes for the site and facility to limit and control the spread of radioactive contamination and to facilitate prompt return to environmental conditions acceptable for unrestricted release of the site. In response, BNI clarified its plans to address unrestricted release of radioactive material, including material contaminated in volume.[161] BNI plans on retaining onsite, material that is contaminated in volume. The draft ERPP and responses to questions described the features that the site and facility possess to limit and control the spread of radioactive contamination and to facilitate prompt return to environmental conditions acceptable for unrestricted release of the site.

The *Waste Treatment Plant Radiological Control Manual* (24590-WTP-MN-ESH-01-001), which was referenced in the draft ERPP, committed to using DOE 5400.5, "Radiation Protection of the Public and the Environment," for unrestricted release. The response to Question LAW-PSAR-128 provided release limits for tritium, transuranics, and other radionuclides present in the waste and provided

[161] "Volume contamination" is defined as "material that has been contaminated in depth (e.g., radioactivity per unit volume or per unit mass)."

references to two release procedures. These commitments were acceptable to the reviewers and should be included in the final ERPP. Local off-Hanford Site background levels are specified annually in *The Hanford Site Environmental Report*.

(e) **Draft ERPP Documentation** – The reviewers found the description of draft ERPP documentation to be acceptable for a draft program. BNI identified existing and anticipated types of activities and areas of the site subject to the ERPP and the measures used to implement the ERPP. Question LAW-PSAR-121 was asked to clarify the full scope of existing and anticipated activities and areas subject to the draft ERPP, including the relationship among the ERPP, the radiation protection program, and the environmental protection program. In response, BNI adequately explained the scope of the draft ERPP and the relationship among programs, and committed to including the information in the ERPP. Question LAW-PSAR-122 was asked to clarify why the ERPP only implemented selected elements of ANSI/ISO-14001, *Environmental Management Systems – Specifications with Guidance*, whereas SRD Safety Criteria 5.3 and 5.4 committed to the entire standard. In response, BNI described how all the required elements from ANSI/ISO-14001 will be addressed. This commitment was acceptable to the reviewers and should be included in the final ERPP.

2. **Effluent Control and Monitoring** – The evaluation of the information for each review area is summarized below:

(a) **Discharge Locations** –The reviewers found the description of discharge locations to be acceptable for a draft program. The interface and transfer points of liquid effluents between BNI and the tank farms contractor, DOE, and other site Contractors were addressed in Section 7 of the draft ERPP, which referenced the following documents: 24590-WTP-ICD-MG-01-006, *Interface Control Document for Radioactive, Dangerous Liquid Effluents*; 24590-WTP-ICD-MG-01-005, *Interface Control Document for Nonradioactive, Nondangerous Liquid Effluents*; 24590-WTP-RPT-ENG-01-002, *Engineering Report for the Waste Treatment Plant On-Site Sewage System*; and the *State of Washington Waste Discharge Permit No. ST 4502*.

Question LAW-PSAR-127 was asked to clarify waste storage. In response, BNI identified 24590-WTP-PF-RT-02-001, *Products and Secondary Waste Plan*, for waste storage, handling, packaging, disposal, and overall management activities. The reviewers identified that the Rad NOC and DWPA[162] included additional information on the air emissions and solid wastes, respectively. The gaseous and liquid effluent discharge locations and their characteristics were documented by BNI in the Rad NOC and DWPA consistent with performing a preliminary independent assessment of environmental impacts and compliance with dose limits. The documentation addressing discharge locations included documents

[162] Prepared as a chapter to the *Dangerous Waste Portion of the RCRA Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Permit Number WA 7890008967.

currently being developed and permit applications[163] that will be updated as the design of the facility progresses. The commitment to provide updated information on discharge locations was acceptable to reviewers and should be included in the final ERPP.

(b) **Effluent Mitigation Measures** – The reviewers found the description of effluent mitigation measures to be acceptable for a draft program. Effluent mitigation measures were described in Section 8 of the draft ERPP. The draft ERPP and 24590-WTP-RPT-ENG-01-002 described how activities will be conducted to prevent discharge of radioactive material to sanitary sewers and committed to controls consistent with the release limits in SRD Safety Criterion 5.3-7.

Section 7 of the draft ERPP, the BARCT, and the Rad NOC also committed to treating effluents with BARCT and maintaining doses ALARA. The BARCT analysis and the Rad NOC will be submitted to and reviewed by the WDOH in phases as the WTP Project progresses. Question LAW-PSAR-124 was asked to clarify how tank or ancillary equipment leakage and detection, monitoring, and removal systems to prevent environmental releases of leaked wastes will be addressed. In response, BNI committed to discussing tank, waste management, piping, and secondary containment systems in the ERPP. This commitment was acceptable and should be included in the final ERPP.

(c) **Physical and Chemical Characteristics of Effluents** –The reviewers found the description of physical and chemical characteristics of effluents to be acceptable for a draft program. RPT-W375-ES-00001, *Integrated Emissions Baseline Report for the River Protection Project Waste Treatment Plant*, contained documentation consistent with performing a preliminary independent assessment of environmental impacts. RPT-W375-ES-00001 is updated annually; updated information on physical and chemical characteristics of effluents should be included in the final ERPP.

(d) **Known or Expected Concentrations of Effluents** – The reviewers found the description of known and expected concentrations of effluents to be acceptable for a draft program. RPT-W375-ES-00001 addressed the known or expected concentrations of radioactive materials in airborne and liquid effluents. Section 7 of the draft ERPP identified the BARCT analysis and the ALARA design process as providing engineering controls that ensure the environmental impacts and doses to the public are ALARA. These commitments to the BARCT analysis and ALARA design process were acceptable to the reviewers, and updated information from the Rad NOC and BARCT on known or expected concentrations of effluents should be included in the final ERPP.

(e) **Sample Identification and Frequency** –The reviewers found the description of sample identification and frequency to be acceptable for a draft program.

[163] The environmental permits that BNI is currently in the process of obtaining include Rad NOC, the BARCT, and DWPA). BNI also needs to be included on the *State of Washington Discharge Permit No. ST 4502*.

Section 9 of the draft ERPP described the interface between environmental regulations and permit conditions and determination of sample identification and frequency. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk" (prepared in response to Question LAW-PSAR-123), BNI identified SRD Safety Criteria 5.3-4, 5.4-1, 5.4-7, and 5.4-8 with sample identification and frequency and stated that sufficient information was not available to present a fully developed sample identification and frequency plan. The commitment to comply with regulations and permits applicable to environmental radiation sample identification and frequency were acceptable to the reviewers and should be included in the final ERPP.

Question LAW-PSAR-118 was asked to clarify how quality was ensured in the draft ERPP. In response, BNI committed to adding to the draft ERPP references to the QAM, which will be updated to include the QA requirements of WAC 246-247. Additionally, WDOH and the EPA may require additional QA plans in the form of Quality Assurance Project Plans for specific WTP activities subject to environmental regulations. Therefore, the QA requirements of WAC 246-247 will be addressed in the QAM and/or Quality Assurance Project Plans. These commitments were acceptable to the reviewers and should be included in the final ERPP.

(f) **Sample Collection and Analysis** –The reviewers found the description of sample collection and analysis to be acceptable for a draft program. Section 9 of the draft ERPP described the interface between environmental regulations and permit conditions and determination of sample collection and analysis. Question LAW-PSAR-123 requested BNI to identify and describe the program or item to meet the requirements of SRD Safety Criteria 5.3-1 and 5.4-10, including environmental sample collection and analysis. In response to the part of the question concerning environmental sampling, BNI provided preliminary information[164] on performing direct measurements, to the extent practicable, to evaluate doses. This information indicated BNI had the capability of performing independent effluent emission testing and monitoring nonpoint and fugitive emissions of radioactive material.

The reviewers found that for the continuous monitoring of radioactive air emissions, BNI proposed equipment and procedures that conform to applicable guidance. The documentation addressing sample collection and analysis, single and multiple sources, and continuous monitoring included documents and permit applications that will be updated as the design of the facility progresses. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," BNI stated that sufficient information was not available to present a fully developed plan for sample collection and analysis. The commitments were acceptable to the reviewers and should be included in the final ERPP.

[164] Documents provided to the reviewers included 24590-WTP-PL-ENV-01-005, *WTP Construction Environmental Control Plan*; 24590-WTP-GPP-SENV-002_0, *Field Implementation of Environmental Notices of Construction*; and 24590-WTP-GPG-SENV-003_1, *Environmental Field Monitoring for Construction*.

(g) **Recording and Reporting of Results** –The reviewers found the description of recording and reporting of results to be acceptable for a draft program. Question LAW-PSAR-120 asked for a description of provisions for managing environmental records and reports, including developing, collecting, verifying, protecting, storing records, and generating reports associated with the ERPP. The documents cited in response to Question LAW-PSAR-120 on records management and document control contained sufficient information to demonstrate a commitment to comply with the dose limit for individual members of the public. In response to Question LAW-PSAR-120 regarding environmental reporting, BNI committed to adding text to Section 9 of the draft ERPP to provide input to *The Hanford Site Environmental Report* (updated annually) and *Radionuclide Air Emissions Report for the Hanford Site* (updated annually) as required by SRD Safety Criteria 9.0-1. The response to Question LAW-PSAR-120(c) regarding environmental records indicated that the BARCT analysis and the Rad NOC would identify/expand the source of input parameters, including the results of all measurements on which they are based, the calculations or analytical methods used to derive values for input parameters, and the procedure used to determine compliance with dose limits. This documentation should be sufficient to allow an independent auditor to verify the facility's compliance as required by SRD Safety Criterion 5.4-9. These commitments were acceptable to the reviewers and should be included in the final ERPP.

(h) **Dose Assessment** – The reviewers found the information on dose assessment to be acceptable for a draft program. Section 9 of the draft ERPP committed to using computer codes or procedures approved by the EPA to determine the results reported to DOE for incorporating into the Hanford Site environmental reporting required by the State of Washington. Question LAW-PSAR-123 requested clarification on the program or item to meet the requirements of SRD Safety Criteria 5.3-1 and 5.4-10, including those related to dose assessment. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk" submitted in response to Question LAW-PSAR-123, BNI identified 24590-WTP-GPP-SENV-013, *WTP Routine Environmental Regulatory Reporting*, as implementing the dose assessment criteria. BNI also committed to providing input to *The Hanford Site Environmental Report* and *Radionuclide Air Emissions Report for the Hanford Site.* These commitments were acceptable and should be included in the final ERPP.

(i) **Action Levels and Actions** – The reviewers found the information on action levels and actions in the draft ERPP to be acceptable for a draft program. Section 9 of the draft ERPP committed to establish appropriate action levels and actions for engineering and administrative effluent controls such that effluent releases conform to the dose standards and the impacts on the environment and the public are ALARA. Question LAW-PSAR-123 was asked to clarify actions and action levels for performing environmental monitoring. BNI's response committed to documenting in more detail in the final ERPP action levels and actions. These commitments were acceptable to the reviewers and should be included in the final ERPP.

(j) **Leak Detection for Tanks and Ancillary Equipment** – The reviewers found the information on leak detection for tanks and ancillary equipment in the draft ERPP to be acceptable for a draft program. The draft ERPP did not address tank or ancillary equipment leakage and detection. Question LAW-PSAR-124 was asked to clarify how tank or ancillary equipment leakage and detection, monitoring, and removal systems to prevent environmental releases of leaked wastes will be addressed. In response, BNI committed to providing leak detection systems for the waste streams in compliance with environmental regulations and permit conditions based on the waste streams being regulated as dangerous waste and also committed to the use of process controls. BNI stated that this was adequate to detect and ensure against any unplanned releases to groundwater, surface water, or soil from tanks and ancillary equipment. The commitments to comply with and implement regulations and permits applicable to leak detection and detection of environmental releases were acceptable to the reviewers and should be included in the final ERPP. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," BNI stated that because the design is preliminary and permits have not yet approved, sufficient information was not available for definitive identification of the methods and instrumentation for leak detection. These commitments were acceptable to the reviewers and should be included in the final ERPP.

(k) **Local, State, and Federal Discharge Permits** –The WDOH, Ecology, EPA, and ORP have approval authority for local, state, and federal discharge permits. The WDOH and Ecology have agreed to a phased approach for granting the Rad NOC and RCRA permits for BNI. All final permit conditions and other approval requirements should be addressed in the final ERPP.

3. **Waste Management** – The evaluation of the information for each review area is summarized below:

(a) **Waste Minimization** – The reviewers found the description of waste minimization to be acceptable for a draft program. The draft ERPP described how both facility design and operations procedures will minimize contamination of materials, the facility, and the environment and the generation of radioactive waste. The draft ERPP referenced three documents related to waste minimization and pollution prevention: *Waste Treatment Plant Radiological Control Manual*; *WTP Waste Minimization/Pollution Prevention Plan*; and *WTP Pollution Prevention/Waste Minimization Program Plan*. Question LAW-PSAR-127 asked for clarification of the waste management program. In response, BNI committed to adding text on the waste management program and referenced 24590-WTP-PL-RT-02-001. The commitments were acceptable to the reviewers and should be included in the final ERPP.

(b) **Handling and Storage** – The reviewers found the description of handling and storage of waste to be acceptable for a draft program. Question LAW-PSAR-127 was asked to clarify how the facility plans to provide for the temporary storage, packaging, and handling of facility generated solid radioactive waste. The draft

ERPP and BNI's response to the question described the temporary storage, packaging, and handling of facility-generated solid radioactive waste, and referenced 24590-WTP-PF-RT-02-001 and the DWPA. The reviewers concluded that the requirements of SRD Safety Criteria 5.3-3 and 5.3-1(8) on radioactive waste should be met when the DWPA is accepted. This document will be submitted in phases to ORP and Ecology for their review. The commitments were acceptable to the reviewers and should be included in the final ERPP.

(c) **Disposal** – The reviewers found the description of waste disposal to be acceptable for a draft program. Question LAW-PSAR-127 was asked to clarify how the facility plans to provide for disposal of radioactive and hazardous waste in conformance with RCRA. The draft ERPP and BNI's response to the question provided information on the timely disposal of radioactive and hazardous waste in conformance with applicable regulations, e.g., RCRA for hazardous waste and SRD Safety Criterion 5.3-3 for radioactive waste. The response to Question LAW-PSAR-127 stated how BNI plans to provide for the timely disposal of radioactive and hazardous waste in conformance with RCRA and referenced the 24590-WTP-PF-RT-02-001 and the DWPA. The reviewers concluded that the requirements of SRD Safety Criterion 5.3-3 on radioactive waste should be met when the DWPA is accepted. This document will be submitted in phases to the ORP and Ecology for their review.

4. **Environmental Monitoring** – The evaluation of the information for each review area is summarized below:

(a) **Background and Baseline** – The reviewers found the description of the background and baseline for environmental monitoring to be acceptable for a final program. Section 10.2.1 of the draft ERPP cited HNF-2067/UC-630, *TWRS Phase I Privatization Site Preconstruction Characterization Report*, as providing the information used to establish background and baseline concentrations of radionuclides in environmental media in the vicinity of the facility. BNI considered this report to be sufficient and appropriate to meet the requirement to develop and implement an environmental surveillance program for pre-operational evaluation. Per 24590-WTP-ICD-MG-01-009, *Interface Control Document for Land for Siting*, an independent third party completed an environmental baseline survey[165] for the land for siting, which documented environmental conditions as of December 1997. Section 4.2 of the LCAR stated, "BNI does not intend to perform additional site characterization." Reviewers accepted the position that BNI does not need to perform additional site characterization.

(b) **Sample Identification and Frequency** – The reviewers found the description of sample identification and frequency to be acceptable for a draft program. Section 9 of the draft ERPP described the interface between environmental regulations and permit conditions and environmental radiological monitoring. The draft

[165] *TWRS Phase I Privatization Site Preconstruction Characterization Report*, HNF-2067/UC-60.

ERPP committed to identifying appropriate environmental samples and a sampling frequency sufficient to demonstrate that dose standards and impacts to the environment and the public resulting from effluent discharges are ALARA. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," BNI stated that because the design is preliminary and permits have not been approved yet, sufficient information was not available to present a fully developed sample identification and frequency program. As discussed in Item 2(e) of this section, the reviewers found acceptable BNI's commitments to comply with and implement in the final ERPP, regulations and permits applicable to environmental radioactive material sample identification and frequency.

(c) **Sample Collection and Analysis** – The reviewers found the description of sample collection and analysis to be acceptable for a draft program. Section 9 of the draft ERPP described the interface between environmental regulations and permit conditions and environmental radiological monitoring. The draft ERPP committed to obtaining appropriate local, state, and federal environmental sample collection permits and appropriate agreements for collecting samples on private property. The draft ERPP stated that environmental media will be sampled and analyzed according to approved procedures, and the analysis will be sufficiently sensitive to demonstrate compliance with the dose standards and to demonstrate that impacts to the environment and the public resulting from effluent discharges are ALARA. In the "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," BNI stated that because the design is preliminary and permits have not yet been approved, sufficient information was not available to present a fully developed program for sample collection and analysis. As discussed in Item 2(f) in this section, the reviewers found acceptable BNI's commitments to comply with and implement in the final ERPP, regulations and permits applicable to environmental radioactive material sample collection and analysis.

(d) **Recording and Reporting of Results** – The reviewers found the description of recording and reporting of results on environmental monitoring to be acceptable for a draft program. The draft ERPP committed to maintaining records sufficient to demonstrate compliance with the dose limit for individual members of the public. Question LAW-PSAR-120 was asked to clarify where records on environmental conditions to support technical requirements and regulatory compliance for environmental sampling and measurements were identified. In response, BNI stated that the BARCT analysis and the Rad NOC would identify/expand the source of input parameters, including the results of all measurements on which they are based, the calculations or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. Documentation will be sufficient to allow an independent auditor to verify the accuracy of any records or reports. BNI committed to preparing an annual report and submitting this report to the ORP and appropriate state and local officials in accordance with the requirements of SRD Safety Criterion 9.0-1. As discussed in item 2(g) of this section, these commitments were acceptable to the reviewers and should be included in the final ERPP.

(e) **Dose Assessment** – The reviewers found the description of dose assessment to be acceptable for a draft program. Report 24590-WTP-GPP-SENV-013 stated that results of environmental monitoring and analysis would be used to annually assess dose to the public and impacts on the environment. This information will be included in the *Radionuclide Air Emissions Report for the Hanford Site* and *The Hanford Site Environmental Report*. BNI requested[166] a change in the wording of SRD Safety Criteria 9.0-1 to allow data from this annual report to be used for both reports. The request was approved on September 26, 2002.[167] Computer codes used to demonstrate compliance with the dose standards were documented in the *Radionuclide Air Emissions Report for the Hanford Site* and *The Hanford Site Environmental Report*. As discussed in item 2(h) of this section, the commitments to dose assessment and reporting were acceptable to the reviewers.

(f) **Action Levels and Actions** – The reviewers found the information on action levels and actions in the draft ERPP to be acceptable for a draft program. The "Environmental Protection/Draft ERPP Safety Criteria Crosswalk" submitted with the response to Question LAW-PSAR-123 cited *The Hanford Site Environmental Report*, Section 2.4, "Environmental Occurrence Reporting," as meeting the requirements of SRD Safety Criterion 5.3-2 to establish appropriate action levels and actions for engineering and administrative effluent controls such that effluent releases conform to the dose standards and their impacts on the environment and the public are ALARA. Occurrence reporting action levels and actions are associated with (1) any unplanned release of a radiological or hazardous substance above established limits defined in applicable regulations, and requiring verbal notification to a regulator, and (2) any event or condition affecting ecological resources (e.g., destruction of a critical habitat, damage to a historic/archeological site, or damage to wetlands) or agreement/compliance areas reportable to a regulator.[168] In "Environmental Protection/Draft ERPP Safety Criteria Crosswalk," BNI acknowledged the preliminary design and that additional documentation would be generated as facility development progresses. Question LAW-PSAR-123 was asked to clarify documentation for actions and action levels for performing environmental monitoring. BNI's response committed to documenting action levels and actions in more detail in the final ERPP. As discussed in item 2(i) in this section, these commitments were acceptable to the reviewers and should be included in the final ERPP.

(g) **Biosphere Modeling** – The reviewers found the information on biosphere modeling in the draft ERPP to be acceptable for a final program. The draft ERPP referenced site-wide documents that require biosphere modeling in order to provide complete environmental reporting, and these documents were also

[166] 24590-WTP-ABCN-ESH-01-021, *Selection of Implementing Standard for Documentation and Submittals*.
[167] 02-OSR-0421, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Approval of Authorization Basis Change Notice (ABCN) 24590-WTP-ABCN-ESH-01-021, Revision 2, 'Selection of Implementing Standard for Documentation and Submittals,'" dated September 26, 2002.
[168] HFID 232.1B, *Notification, Reporting, and Processing of Operations Information*.

referenced in the response to Question LAW-PSAR-123. The commitments to performance of biosphere modeling were acceptable to the reviewers.

(h) **Meteorological Data Acquisition** – The reviewers found the information on meteorological data acquisition to be acceptable for a final program. SRD Safety Criterion 5.4-10(1) states that DOE will maintain the Hanford Site Air Operating Permit (AOP) and provide access to meteorological data. The draft ERPP referenced site-wide documents that require meteorological data to be acquired to provide complete environmental reporting, but the draft ERPP did not specifically discuss meteorological data acquisition. Question LAW-PSAR-123 was asked to clarify meteorological data acquisition. BNI's response identified the *Radionuclide Air Emissions Report for the Hanford Site* as implementing SRD Safety Criterion 5.4-10(1) on meteorological data acquisition. The reviewers concluded that BNI provided sufficient information in the draft ERPP to demonstrate that the requirements of SRD Safety Criterion 5.4-10(1) and this requirement of the Contract will be met.

5.9.3 Conclusions

The reviewers concluded that the draft ERPP was acceptable as a draft program. The submittal was consistent with previously approved submittals including BNI's documented radiation protection program and the LCAR. The final ERPP to be submitted with the authorization for production operations should include the commitments described above to be acceptable as a final program.

5.10 Plan for Operational Assessment Reports (Draft)

The purpose of this review was to determine whether BNI had a draft Plan for Operational Assessment Reports in place at the start of construction. Internal safety oversight for the operation of the WTP will involve ongoing BNI assessments of operations to ensure the safety of the public and workers and to preclude environmental degradation.

5.10.1 Requirements

The BNI Contract, Section C, Standard 7, Table S7-1, contains the requirement for a draft plan for Operational Assessment Reports, requiring a draft plan be submitted and approved at the start of construction. The final plan for operational assessment reports should address the periodic requirements associated with the oversight process determination regulatory action, as outlined in Sections 3.3.5 and 4.5, both titled "Oversight Process Determination, " of DOE/RL 96-0003.

Section 4.5.2 listed several actions required by BNI, including (1) maintaining a list of ABCNs; (2) submitting unusual occurrence reports describing events or conditions and recommended corrective actions; (3) maintaining, in a current state, the FSAR, SRD, TSR, and key supporting

documents that are materially part of the authorization basis; and (4) supporting the resolution of USQs.

5.10.2 Evaluation

The reviewers evaluated 24590-WTP-PL-ESH-02-002, *Plan for Operational Assessment Reports* and found it to be acceptable. The draft plan committed to assess project activities and programs, including changes that could adversely affect safety or performance. The draft plan included maintenance of records summarizing proposed changes for which a safety evaluation was required and implemented, including physical (e.g., site-related, equipment, and structures), procedural (including tests and experiment), and administrative changes. It also included assessments of USQ evaluations, emergency response actions and drills, unusual occurrence reports, QA program, fire protection program, the criticality safety program, training program, maintenance program, TSRs surveillance program, and radiation dose reports.

The draft plan further stated that hot commissioning and operational phase procedures directing assessment performance will be implemented upon DOE approval to begin facility operations. Procedures will address assessments of specific technical activities. In addition, a procedure will be written to implement QAM, Policy Q-18.3. The procedures will specify the process for planning, performing, and documenting the subject assessments. Results and conclusions from the assessments will be evaluated by appropriate WTP project managers, and findings will be tracked and resolved.

The draft plan also stated that the facility manager will be responsible for submitting an annual update of the operating authorization basis documents to keep the documents in a current state.

5.10.3 Conclusion

The reviewers concluded that the draft Plan for Operational Assessment Reports for the hot commissioning and operations phases was acceptable as a draft plan. ORP will evaluate the final Plan for Operational Assessment Reports in connection with the authorization for hot commissioning regulatory action.

6.0 EVALUATION - CAR REQUIREMENTS

In addition to submittal of a PSAR for construction authorization, BNI was required to submit additional documentation demonstrating that it was ready for construction.[169] Evaluation of the additional documentation is discussed in this section.

6.1 Contractor's Technical and Experience Qualifications to Construct the Plant

The purpose of this review was to determine whether the CAR adequately described the required technical and experience qualifications to construct the WTP.

6.1.1 Requirements

DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," contains the requirements for technical and experience qualifications, stating, "A construction authorization will be issued by the ORP Manager (following review/concurrence from EM) based upon the determination and recommendation of the SRO that: 5. The Contractor is qualified by reason of experience and training to perform the proposed construction." In addition, RL/REG-99-05, Section F, "Contractor's Technical and Experience Qualifications to Construct the Plant," provided the following supplemental review criteria:

- "**Technical Qualifications** – BNI's technical qualifications reasonably ensured that the waste processing plant can be designed, built, and safely operated to accomplish the WTP mission. BNI described the relative technical experience of the team assembled to design and build the plant as well as the technical qualifications of the parent companies. This experience should include specific examples of directly related experience of the individuals (e.g., the project managers, area project managers, design managers, construction managers, operations managers, industrial safety managers, and environmental managers or their equivalent) in designing and constructing similar plants.

- **Experience Qualifications** – BNI's experience qualifications in constructing similar plants for processing nuclear waste reasonably ensured that the plant can be built and safely operated to accomplish the WTP mission. BNI described similar plants that have been constructed by the parent companies and the operating performance of the plants once completed."

[169] DOE/RL-0003, Section 4.3, "Authorization for Construction."

6.1.2 Evaluation

BNI addressed its qualifications to construct the WTP in Attachment 10 of its PCAR submittal.[170] BNI cited the experience of Bechtel and the Washington Group in constructing and operating the Defense Waste Processing Facility at the Savannah River Site and the West Valley Demonstration Project to treat HLW. The BNI project manager had direct experience at the Savannah River Site in constructing the facility. The BNI operations manager managed the Defense Waste Processing Facility and the tank farms at the Savannah River Site and the West Valley Demonstration Project.

BNI's ES&H manager led the safety analysis program for the Defense Waste Processing Facility. BNI's environmental manager led environmental programs in the DOE complex at Fernald and at West Valley facilities and achieved DOE's Voluntary Protection Program Star status at West Valley. BNI's QA manager had considerable experience in nuclear QA management, startup, and operations. Overall, BNI obtained considerable vitrification experience by selecting managers, engineers, and others from the two U.S. vitrification projects at Savannah River and at West Valley. BNI also selected managers with considerable construction experience at DOE facilities. BNI further cited its experience in managing the environmental restoration program at the Hanford Site. Biographical information was provided on key individuals.

6.1.3 Conclusions

Based on the information provided in Attachment 10 to the PCAR submittal, the reviewers concluded that BNI met the technical and experience qualifications to construct the WTP.

6.2 Approach to Implement the Construction and Preoperational Portions of the SRD and ISMP

The purpose of this review was to determine whether BNI adequately described its approach to implementing the construction portions of the SRD and ISMP as they applied to constructing the full LAW, HLW, PT, and BOF facilities.

6.2.1 Requirements

The submittal on approach to implementing the construction portions was acceptable if the following criteria were met:

1. The submittal or revisions to the SRD and ISMP clearly delineated which portions of the SRD and ISMP pertain to construction and preoperational testing.

[170] CCN: 026767, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the River Protection Project – Waste Treatment Plant, Attachment 10, 'Contractor's Technical and Experience Qualifications to Construct the Plant,'" dated November 12, 2001.

2. An approach was described to ensure that the relevant portions of the SRD and ISMP are implemented.

3. The approach was consistent with the approaches described in the ISMP (i.e., Section 4.1, "Safety Management Processes") for ensuring that the SRD's safety criteria are implemented.

4. The approach described construction and preoperational testing procedures that adequately ensure that the construction-related part of the SRD will be properly implemented. Alternatively, for construction or preoperational testing procedures that are not developed before the CAR is submitted, sufficient descriptions were provided to ensure that the construction and preoperational testing portions of the SRD and ISMP are implemented.

6.2.2 Evaluation

The reviewers were unable to determine from the CAR submittal whether BNI had identified the applicable portions of the SRD and ISMP. In response to Question LAW-PSAR-009 requesting this information, BNI stated that it had, and that the applicable citations to the SRD and ISMP were contained in the "requirements" subsection of each chapter of the PCAR. The reviewers further questioned (Question LAW-PCAR-009) whether BNI had developed processes and procedures to implement the regulatory commitments. BNI responded that management controls were in place for developing, reviewing, and approving plans, programs, and procedures to address conformance to the authorization basis, including the SRD and ISMP. In addition, procedures to support specific PCAR construction activities were identified and confirmed as part of a BNI self-assessment of its readiness to proceed with partial construction.[171] ORP confirmed in Inspection Report IR-02-008[172] that these procedures had been identified and confirmed.

The reviewers also questioned (Question LAW-PCAR-009) how the self-assessment and declaration of readiness activities would be performed. BNI responded that it would complete a self-assessment, including an assessment of compliance with applicable portions of the SRD and ISMP, as part of its declaration of readiness to proceed with construction of the basemat. BNI subsequently submitted two letters to ORP declaring its readiness to proceed with Partial Construction Authorization activities.[173, 174] The reviewers asked (Question LAW-PSAR-027) BNI for its assessment of its compliance to the SRD and ISMP. BNI's response expanded its commitments for the PCAR to the full facility.

[171] CCN: 034798, BNI letter from A. R. Veirup to W. J. Taylor, ORP, "Declaration of Readiness for Partial Construction Authorization Activities," dated June 12, 2002.
[172] 02-OSR-0352, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Inspection Report IR-02-008 – On-Location Inspection Report for the Period May 24 Through July 16, 2002, Including an Assessment of Contractor Readiness to Perform Partial Construction Authorization Activities," dated August 26, 2002.
[173] CCN: 034798, BNI letter from R. F. Naventi to W. J. Taylor, ORP, "Declaration of Readiness for Partial Construction Activities," dated June 12, 2002.
[174] CCN: 036196, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Declaration of Readiness for Partial Construction Activities," dated July 9, 2002.

The reviewers found the submittal and the responses to Questions LAW-PCAR-009 and LAW-PSAR-027 to be acceptable.

6.2.3 Conclusions

The reviewers concluded that the approach to implementing the construction and preoperational portions of the SRD and ISMP during full facility construction was acceptable.

6.3 SRD and ISMP Acceptability and Compliance

The purpose of this review was to determine whether BNI is compliant with the SRD and ISMP. The reviewers determined compliance by integrating the results of the PSAR review with the results of ORP assessments of BNI as they relate to SRD and ISMP activities.

6.3.1 Requirements

DOE/RL-96-0003, Section 3.3.3, "Authorization for Construction," Items 1 through 3, contain the requirements for reviewing the Contractor's compliance to the SRD and ISMP and state that construction authorization will be issued by the ORP Manager (following approval/concurrence from DOE's Office of Environmental Management), based on the Safety Regulation Official's determination and recommendation that (1) "the Contractor's important-to-safety activities are being conducted according to its approved ISMP, (2) the proposed changes to the SRD and ISMP are acceptable, and (3) the Contractor's design complies with the design-related part of the updated SRD."

RL/REG-99-05, Section H, "SRD and ISMP Acceptability and Compliance," interprets this contractual requirement by stating that compliance to the SRD and ISMP was acceptable if the following criteria were met:

1. BNI provided an assessment of compliance to the SRD and ISMP (as required by DOE/RL-96-0003, Section 4.3.2).

2. The safety-related activities will be conducted according to the approved ISMP.

3. The design complied with the design-related portions of the SRD.

4. The proposed changes to the SRD and ISMP were acceptable.

5. The SRD complied with the requirement of the SRD, Section 3.6, "Maintenance of the SRD," and Section 4.0, "Confirmation Process."

6. Revisions to the SRD complied with the SRD, Appendix A, "Implementing Standard for Safety Standards and Requirements Identification."

7. The SRD and ISMP complied with the ISMP, Section 3.3.2, "Control of the Authorization Basis."

8. BNI adequately followed the procedure described in the SRD, Section 3.6, "Maintenance of the SRD," for independent review and assessment of SRD changes.

6.3.2 Evaluation

The reviewers evaluated SRD and ISMP acceptability and compliance by integrating the results of all PCAR and PSAR reviews with the results of ORP assessments of BNI as they related to the PSAR activities. The evaluation of the information for each criterion is summarized below:

1. **Assessment of Compliance with the SRD and ISMP** – The reviewers found BNI's assessment of compliance with the SRD and ISMP to be acceptable. The reviewers determined that the PSAR did not contain an assessment of compliance to the SRD and ISMP. However, in response to Question LAW-PSAR-027 concerning BNI's assessment of its own compliance to the SRD and ISMP, BNI defined the process[175] for construction authorization. This process was acceptable to the reviewers.

   BNI submitted two letters to ORP declaring its readiness to proceed with Partial Construction Authorization activities.[176, 177] As described in Section 6.2.2 of this SER and in response to Question LAW-PSAR-027, BNI committed to perform self-assessments and to provide similar declarations of readiness to proceed with full LAW, HLW, and PT facility construction. BNI also stated that applicable citations to the SRD and ISMP were contained in the "requirements" subsection of each PSAR chapter and that the applicable SRD and ISMP requirements were reviewed and approved as an integral part of the project-wide PSAR review and approval process. The reviewers determined that correct and comprehensive citations were provided in each case.

   ORP established a program[178] for inspecting BNI's conformance to requirements established by the authorization basis, of which the SRD and ISMP are a part. The inspection program's specific requirements are documented in inspection procedures (http://www.hanford.gov/osr/index.cfm) that ORP has reviewed and approved. Each procedure identifies requirements for the inspectors who implement the procedure during an inspection. Each inspection requirement specifically identifies the source of the requirement in the SRD and ISMP. Accordingly, ORP's inspection program requires verifying on a sampling basis BNI's conformance to SRD and ISMP requirements.

[175] CCN: 024490, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Request for Review and Approval of the Partial Construction Authorization Request for the Hanford Tank Waste Treatment and Immobilization Plant, Attachment 6, 'Approach to Implement the SRD and the ISMP,'" dated December 10, 2002.
[176] CCN: 034798, BNI letter from R. F. Naventi to W. J. Taylor, ORP, "Declaration of Readiness for Partial Construction Activities," dated June 12, 2002.
[177] CCN: 036196, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Declaration of Readiness for Partial Construction Activities," dated July 9, 2002.
[178] RL/REG-98-05, *Inspection Program Description for Regulatory Oversight of the RPP-WTP Contractor.*

ORP implemented a program for inspecting BNI's conformance to the SRD and ISMP at the start of the Contract in December 2000. About 30 inspections have been completed to date. ORP documents the results of each inspection in an inspection report issued to BNI and available for public review (http://www.hanford.gov/osr/index.cfm). Each inspection report provides a conclusion on BNI's conformance to the specified requirements and the basis for the conclusion.

ORP also established and implemented a program for correcting conditions found during inspections that do not conform to the SRD and ISMP requirements. The nonconforming conditions are identified in ORP inspection reports, entered into a tracking system, and evaluated during a subsequent inspection to assess BNI's corrective action to return to conformance with the SRD and ISMP. The basis for determining and concluding a return to conformance is documented in the inspection report.

Accordingly, ORP established and implemented a program for assessing the degree of BNI conformance with SRD and ISMP requirements and ensuring compliance. The inspection program has established confidence that BNI is conforming to SRD and ISMP requirements in the areas evaluated during inspections.

Before issuing the construction authorization, ORP performed inspections in the following areas:

- CM (Inspection Report IR-02-007, *Configuration Management*)
- Standards selection (Inspection Report IR-02-013, *Standards Selection*)
- Standards implementation (Inspection Report IR-02-012, *Safety Requirements Document Design Standards Implementation*)
- Design process implementation (Inspection Report IR-02-015, *Design Process Assessment*).

The results of these inspections identified a number of deficiencies with the performance of engineering work (e.g., calculation accuracy).

In October, ORP notified BNI[179] of these deficiencies regarding the performance of engineering work as it related to the design process and stated BNI must demonstrate that its plans and actions had comprehensively addressed the design process deficiencies in order for ORP to conclude BNI was ready for construction. BNI met with ORP on October 7, 2002, and presented its analysis of the engineering performance deficiencies and identified compensatory measures and corrective actions. In a letter dated

[179] 02-OSR-0480, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Notification of Construction Authorization Readiness Assessment and Associated Concerns," dated October 4, 2002.

October 30, 2002,[180] BNI provided a comprehensive corrective action plan to resolve the engineering deficiencies and its justification to proceed with construction upon completion of the immediate corrective actions.

Before issuing the Construction Authorization Agreement for LAW and HLW full facility construction, PT facility pits, tunnels, and basemat, and selected portions of the BOF, ORP completed a readiness inspection for construction authorization. ORP reviewed BNI's corrective action plan and concluded the evaluations and proposed corrective actions were adequate. ORP conducted inspections from November 4-7, 2002, to assess the actions taken to address the concerns identified by the ORP letter dated October 4, 2002, and concluded that BNI's implementation of the proposed corrective actions was adequate to support construction authorization of the full LAW and HLW facilities,[181] subject to the following condition: "BNI will implement the corrective actions specified in Attachment 2, 'Assessment of the Effect of Design Process Implementation Issues on Construction Authorization Readiness,' to the BNI letter dated October 30, 2002.[182] These corrective actions must be completed by the dates provided in the letter." Closure of the 16 corrective actions and commitments will be confirmed during the PT CAR readiness inspection to be conducted in March 2003.

A similar readiness inspection will be conducted prior to issuing the Construction Authorization Agreement for full PT facility construction. The ORP readiness inspection will verify that the corrective actions identified in the BNI letter of October 30, 2002, have been completed and that the corrective action can be closed. Results of the readiness inspection, together with Revision 3 of the SER, will form the basis of issuing the PT facility Construction Authorization Agreement.

On February 26, 2003, BNI notified ORP of its declaration of readiness to proceed with full PT facility construction authorization activities.[183] This letter provided additional details regarding the corrective actions provided by the October 30, 2002, letter (CCN: 042775). BNI's assessment included a review of a broad range of areas associated with the initiatives to improve performance of engineering work. In addition, BNI concluded that PT facility design to begin full construction work activities.

ORP conducted a readiness inspection from March 3-13, 2003, prior to issuing the Construction Authorization Agreement for full PT facility construction.[184] The ORP

[180] CCN: 042775, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Hanford Tank Waste Treatment and Immobilization Plant – Construction Authorization Readiness in Consideration of Recent Assessments and Inspections of Engineering Activities," dated October 30, 2002.
[181] 02-OSR-0586, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Inspection Report A-03-OSR-RRPWTP-002 – Construction Authorization Request Readiness Inspection," dated December 10, 2002.
[182] CCN: 042775, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Hanford Tank Waste Treatment and Immobilization Plant – Construction Authorization Readiness in Consideration of Recent Assessments and Inspections of Engineering Activities," dated October 30, 2002.
[183] CCN: 048490, BNI letter, R. F. Naventi to R. J Schepens, ORP, "Readiness for Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility Full Construction," dated February 26, 2003.
[184] 03-OSR-0110, ORP letter from R. J. Schepnes to R. F. Naventi, BNI, "Pretreatment Facility Construction Authorization Readiness Inspection Report, A-03-OSR-RPPWTP-011," in preparation.

readiness inspection assessed whether the corrective actions identified in the BNI letter of October 30, 2002, had been completed and the corrective actions were closed. The readiness inspection also assessed the adequacy of selected PT facility design documents and the effectiveness of the initiatives to improve performance of engineering work identified by the BNI in its October 30, 2003, and February 26, 2003, letters.

The readiness inspection found that BNI had initiated extensive corrective actions to improve engineering work performance. Because these corrective actions had been implemented recently, the team could not assess their effectiveness. Consequently, to provide assurance that the corrective actions are timely and effective, as a condition of approval, BNI agreed to "perform a thorough assessment of the effectiveness of the engineering work performance improvement initiatives for all disciplines performing engineering design work, submit the assessment results, and identify any additional corrective actions deemed necessary" before the first revision of the PSAR following authorization for full facility construction. With this condition, the readiness inspection concluded that ITS activities were being conducted consistent with the requirements of the SRD and ISMP and should provide adequate safety.

2. **Conduct of Safety-Related Activities According to the ISMP** – The reviewers found BNI's compliance to the safety-related portions of the approved ISMP[185] to be acceptable because (1) the PSAR was consistent with the ISMP and (2) inspection findings of noncompliance were subsequently remedied as documented in BNI corrective action reports. The reviewers evaluated the PSAR activities that BNI identified that may impact ITS SSCs to ensure that they were conducted according to the approved ISMP. Details of these evaluations are found in Sections 3.0 and 4.0 of this SER. No cases of noncompliance with the ISMP's requirements were identified.

3. **Compliance of the Design with the SRD** – The reviewers evaluated all PSAR submittal sections to determine if they complied with the approved SRD. The reviewers determined the PSAR generally complied with the SRD safety criteria with the following exceptions:

   (a) PSAR Volume IV, Section 4.3.7.4, stated that ASME Section VIII[186] would be used for designing and constructing HLW vessels. This was consistent with SRD Safety Criterion 4.2-2, which specifies the use of ASME Section VIII for designing pressure vessels, tanks, heat exchangers, and valves. However, the PSAR did not address the design of supports for these components. In response to Question HLW-PSAR-163 concerning the technical adequacy of mixing codes (i.e., ASME Section III, "Rules for Construction of Nuclear Power Plant Components," with ASME B31.3, "Process Piping," and ASME VIII), BNI stated that, "Vessel analysis and acceptance will be to ASME, Section III, Div. 1, Subsection NC, the support analysis method and acceptance will be to ASME,

[185] Sections 4.1 through 4.4 of this SER conclude that the submittals adequately described the hazard and accident analyses performed for the LAW, HLW, PT, and BOF facilities, respectively, and that the analyses complied with the SRD and ISMP.
[186] Boiler and Pressure Vessel Codes, "Rules for Construction of Pressure Vessels."

Section III, Div.1, Subsection NF, and the seismic loading will be by response spectra." BNI further stated, "The WTP project is aware that ASME, Section III is not currently called out in the SRD. The project will take the necessary actions (before construction authorization for PT) to tailor standards to add the ASME, Section III methodology for seismic and fatigue analysis of vessels and supports or use alternative methodology already in the SRD." As of December 31, 2002, BNI had not provided an authorization basis amendment request to tailor standards for analysis of vessels and vessel supports. Contract Standard 7, Section (d) states, "The Contractor shall conduct work in accordance with the Contractor developed and DOE approved Safety Requirements Document." Accordingly, BNI is required to follow the SRD Safety Criteria and implementing standards for design and analysis of vessels and vessel supports.

(b) PSAR Volume I, Table 2-6, presented the criteria for designing piping and piping supports for SC-I, -II, -III, and -IV systems. The table showed that ASME Section III acceptance criteria would be used for determining permissible stresses or capacities. Because SRD Safety Criterion 4.2-2 specifies ASME B31.3-1996 as the implementing code for piping system design rather than ASME Section III, the reviewers found the use of ASME III criteria to be inconsistent with the SRD. In some cases, the acceptance criteria proposed by BNI were less stringent than those in the SRD. Reviewers questioned (Question PT-PSAR-339) the technical adequacy of mixing codes (i.e., ASME III with ASME B31.3 and ASME VIII). In response to Question PT-PSAR-339, BNI stated that, "Piping and pipe supports will be designed in accordance with the SRD and that PSAR General Information Volume I; Table 2-6, Categorization of Piping; Section 2.4.9, Piping Design; and Section 2.4.10, Pipe Support Design will be updated to agree with the SRD in the first revision of the PSAR after full facility construction authorization." Reviewers found this commitment acceptable.

(c) For both the LAW and HLW facilities, the reviewers determined that all of the instrumentation and controls required to place the facility in a safe state were not identified as ITS SSCs, as required by SRD Safety Criterion 4.3-4. As discussed in Sections 4.1.3.2, 4.2.3.2, and 4.3.3.2 of this SER, BNI committed to include a listing of all RRC SSCs, including their safety functions, in the first PSAR revision following authorization for full facility construction.

(d) The credited safety function of the LAW facility structure was to prevent chemical (NO_x) consequences to the worker, as discussed in the Section 4.4.1.3 of the LAW PSAR. In Section 4.1.2.2, Item 8, of this SER, the reviewers identified that the LAW facility structure had an additional safety function, namely, to support the physical barrier of the process cell, as required by Table 1 of the SRD, Appendix B, "Implementing Standards for Defense in Depth." BNI committed to correct this in the first PSAR revision following authorization for full facility construction.

(e) As discussed in this SER, Section 4.1.2.2, Item 8, the reviewers identified additional safety functions for the LAW facility structure based on the seismic

DBE event being SL-2 for the facility and co-located worker, the mis-feed event being SL-1 for the facility worker, and the liquid spill/overflow from the LAW concentrate receipt vessel being SL-2 for the facility worker. The reviewers verified that, notwithstanding these omissions, additional LAW ITS SSCs beyond those already provided were not required. As noted in Section 4.1.2 of this SER, BNI committed to revise the PSAR to correct the omission of additional safety functions for the basemat in the first PSAR revision following authorization for full facility construction.

(f) Section 4.2.2 of Revision 2 of this SER noted that BNI had not yet determined the combined effects of seismically induced radiological releases from the PT, LAW, and HLW facilities. BNI subsequently completed the seismic probabilistic risk analysis, demonstrating the seismic risk of the facility was a small fraction of the risk goals. (See Section 4.6 of this SER.)

(g) As indicated in the HLW PSAR, Sections 2.4.13.4 and 2.4.14.11, a facility control room and standby control room were planned for the HLW facility; however, no explanation was provided in the PSAR regarding how control room monitoring and control requirements of SRD Safety Criteria 4.3-4 and 4.3-7 apply, including associated implementing codes and standards.

Question HLW-PSAR-224 asked how the requirements of SRD Safety Criteria 4.1-1, 4.3-1, 4.3-4, and 4.3-7 were to be met by the control room strategy. BNI's response stated that the PT facility main control room will have monitoring and control capability to achieve and maintain a safe state for the HLW processes.

BNI committed to provide initial information in the next PSAR revision and full information when the FSAR is submitted. This commitment was acceptable to the reviewers.

(h) The reviewers found that the fire hazard analysis consistency with the SRD was conditionally acceptable. Before the PSAR was submitted, ORP identified in ORP/OSR-2001-06 that the SRD fire protection criteria were not consistent with the requirements of 10 CFR 830, relative to the "safe harbor" nuclear safety design criteria of DOE O 420.1A. Specifically, requirements that automatic fire suppression be provided in all areas where damage from a fire could exceed one million dollars and that redundant safety class equipment be placed in separate fire areas had not been incorporated in the SRD. Near the end of the PSAR review, BNI submitted ABCN 24590-WTP-ABCN-ESH-02-026, *Compliance with DOE-O-420.1A, Facility Safety*, to correct this deficiency. Revised SRD criteria that were consistent with DOE O 420.1A were approved on October 21, 2002. Using the revised SRD criteria, the reviewers noted that the PSAR did not provide for automatic fire suppression for all areas where the damage from fire could exceed one million dollars, as required by Safety Criterion 4.5-4. (The PSAR was appropriately silent concerning whether redundant SDC cabling would be located in separate fire areas because this detail was beyond the scope of preliminary design and the PSAR.)

On October 15, 2002, BNI requested approval of alternate fire protection design criteria to modify the requirements discussed above. During a meeting between DOE (ORP and DOE Headquarters Office of Environment Management) and BNI personnel on December 10, 2002, DOE identified concerns with the alternate fire protection design criteria request. As a result, BNI will revise and resubmit the request for alternate fire protection design criteria. However, from the information provided in the request, the reviewers concluded that an acceptable automatic suppression system could be installed in the affected areas, if the request is not approved. Therefore, for all but nine rooms in the HLW building (per revised SRD Safety Criterion 4.5-4 and 24590-WTP-ABAR-ENS-03-008, *Modification of SRD Safety Criterion 4.5-4 to Allow Omission of Automatic Fire Suppression Systems from High Radiation Areas*), DOE is imposing a condition on the construction that BNI must retain the option to design and install automatic fire suppression for the affected areas and is not authorized to construct SSCs that implement control strategies that are inconsistent with meeting the current SRD requirements. In this context, "inconsistent" is defined as refers to strategies that significantly impede the capability to efficiently change the design to meet the SRD requirement, should that ultimately be necessary. In addition, if the alternate criteria request is not approved, BNI must amend the hazard evaluation for the automatic fire suppression system and obtain DOE approval of the amendment, on a mutually agreed upon schedule, before commencing construction that implements these control strategies.

On the basis that BNI has provided the acceptable commitments described above to modifying the PSAR to correct the areas of noncompliance, the reviewers determined that compliance of the WTP design with the SRD was conditionally acceptable.

4. **Proposed Changes to the SRD and ISMP** – Review of the Standards Approval Package (i.e., revised SRD, ISMP, and QAM) is also related to the CAR. The Contract, Standard 7, Paragraph (e)(2)(v), requires BNI to submit a revised Standards Approval Package, including all necessary supporting documentation to support DOE review and approval of the CAR.

   BNI submitted the revised Standards Approval Package, not as three revised documents as required by the Contract (i.e., a revised SRD, ISMP, and QAM), but as a number of individual ABCNs, ultimately numbering over 31. The initial group of 25 ABCNs was submitted consistent with the Contract date for submittal of the revised Standards Approval Package. Several additional ABCNs were submitted after the CAR submittal date had passed. All the ABCNs, including those submitted after the CAR target date for submission had passed, were reviewed to ensure that the safety commitment was consistent with that required by the SRD and top-level standards, laws, and regulations; and an SER was issued for each ABCN on the proposed changes. The details of these reviews are not documented in this SER but can be found on the ORP website (http://www.hanford.gov/osr/index.cfm). After construction authorization, an updated SRD and ISMP will be issued that includes all of the changes to the SRD and ISMP that ORP has approved to date.

Many of the ABCNs submitted by BNI required further information to support approval. In many cases, the safety evaluation presented in the initial submittal was incomplete. The reviewers provided questions to BNI and through the question/answer process, the reviewers were able to obtain the information needed to approve the ABCNs. The reviewers determined that BNI is following the requirements for maintaining the SRD, although the initial submittal of ABCNs frequently required requests for additional supporting information.

The Standards Approval Package also includes revisions to the QAM. ORP approved the most recent QAM on June 5, 2002.[187]

On the basis that the SRD, ISMP, and QAM have been reviewed and approved by ORP, reviewers determined that the revised Standards Approval Package for construction was acceptable.

5. **SRD Compliance with SRD Requirements (Volume I), Sections 3.6 and 4.0 –** Maintenance of the SRD was previously covered by the SRD, Volume I, Sections 3.6, "Maintenance of the SRD," and 4.0, "Maintenance of the SRD." However, with approval of ABCN 24590-WTP-ABCN-ESH-01-001,[188] *Revision to ISM Process and Defense in Depth (SRD Appendices A & B)*, to eliminate Volume I of the SRD, the requirements were moved to SRD Volume II, Appendix A, Section 11.0, "Maintenance Process," and Section 8.0, "Confirmation of Standards Process."

   Notwithstanding the discrepancies and inconsistencies noted in Section 6.3.2.3 of this SER, the reviewers determined that maintenance of the SRD and the fidelity of the confirmation process was acceptable because BNI had complied with the SRD, Volume II, Appendix A, Sections 8.0, "Confirmation of Standards," and 11.0, "Maintenance Process." This conclusion was based on review of 31 ABCNs submitted to ORP from January 15, 2002, through October 8, 2002; most of the 31 ABCNs were part of the revised Standards Approval Package. ORP determined that BNI is following the requirements for maintenance of the SRD as stated above.

6. **Compliance of SRD Revisions with Appendix A of the SRD –** The SRD standard that applies to selecting implementing standards for each safety criterion in the SRD is Appendix A, "Implementing Standard for Safety Standards and Requirements Identification." Compliance to Appendix A is a regulatory requirement. ABCNs 24590-WTP-ABCN-ESH-01-029 and 24590-WTP-ABCN-ESH-01-001 were the only ABCNs that impacted how implementing standards would be selected for the WTP design. Each ABCN is discussed separately, below:

[187] 02-OSR-0209, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Office of Safety Regulation (OSR) Approval of Bechtel National, Inc (BNI) Authorization Basis Change Notices ABCN-24590-01-00007, Revision 0, 24590-WTP-ABCN-ESH-01-022, Revision 0, 24590-WTP-ABCN-ESH-02-007, Revision 0, 24590-WTP-ABCN-ESH-02-008, Revision 0, 24590-WTP-ABCN-ESH-02-009, Revision 0," dated June 5, 2002.

[188] 02-OSR-0449, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of Bechtel National Inc Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-001, Revision 1, 24590-WTP-ABCN-ESH-01-029, Revision 1, and Partial Approval of 24590-WTP-ABCN-ESH-02-019, Revision 0," dated October 3, 2002.

(a) In 24590-WTP-ABCN-ESH-01-029, Revision 0, BNI proposed the concept of RRC SSCs. This ABCN initially proposed that the RRC SSCs would be designed to "normal industrial standards." ORP took exception to this proposal and rejected the ABCN in its initial review.[189] Revision 1 of 24590-WTP-ABCN-ESH-01-029[190] responded to ORP's concerns and ORP approved the ABCN. Instead of designing RRC items to normal industrial standards, the RRC proposal was changed to require that RRC SSCs be designed to standards that would be developed through the process outlined in Appendix A of the SRD. This application of the process will be evaluated in the ORP inspection process.

During the LAW, HLW, and PT PSAR reviews, the reviewers asked for further clarification of BNI's plan to use RRC classification for ITS SSCs.[191] The evaluation of the PSAR's treatment of RRC is presented in Sections 4.1.3.2, 4.2.3.2, and 4.3.3.2 of this SER and was found to be acceptable.

(b) Revision 1 of 24590-WTP-ABCN-ESH-01-001 proposed modifying the wording in selected sections of SRD Volume II, Appendices A, B, and D (Revision 0), and modifying several sections of the ISMP. The more significant proposed changes to SRD Volume II, Appendix A, included (1) adding requirements for evaluating chemical and direct radiation hazards, (2) revising the presentation of common-mode and common-cause failures, (3) replacing the details on SSC classification and quality attributes with references to SRD Safety Criterion 1.0-8 and the QAM, and (4) adding new information on maintenance of the SRD. For SRD Volume II, Appendix B, the more significant BNI proposals included adding requirements for evaluating chemical and direct radiation hazards. ORP approved the ABCN on October 3, 2002.[192]

Reviewers determined that BNI was in compliance with all of the proposed changes to Appendices A, B, and D of the SRD because each proposed revision described in 24590-WTP-ABCN-ESH-01-001 was consistent with the version of Appendix A that preceded the changes and continued to provide adequate safety to the workers, the public, and the environment as described in the corresponding SERs to these ABCNs.

7. **Compliance of the SRD and ISMP with ISMP Section 3.3.2 –** The ISMP, Section 3.3.2, "Control of the Authorization Basis," states the following:

[189] 02-OSR-0029, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Rejection of Revision to Standards Requirements Document (SRD), Bechtel National, Inc. (BNI) SRD Standards Approval Package Submittal," dated January 30, 2002.
[190] 02-OSR-0449, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of Bechtel National Inc Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-001, Revision 1, 24590-WTP-ABCN-ESH-01-029, Revision 1, and Partial Approval of 24590-WTP-ABCN-ESH-02-019, Revision 0," dated October 3, 2002.
[191] Questions LAW-PSAR-024, -025, -026, -066, -100, and -101.
[192] 02-OSR-0449, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of Bechtel National Inc Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-001, Revision 1, 24590-WTP-ABCN-ESH-01-029, Revision 1, and Partial Approval of 24590-WTP-ABCN-ESH-02-019, Revision 0," dated October 3, 2002.

> "The authorization basis for WTP is considered as an element of the technical baseline for the facility. Changes to the technical baseline are managed by a configuration management program. For further information concerning configuration management see ISMP Sections 1.3.16 and 5.3, 'Configuration Management.'"

Based on review of 31 ABCNs submitted to ORP during January 15, 2002, through October 8, 2002, most of which were part of the revised Standards Approval Package, ORP determined that BNI was following the requirements for control of the authorization basis. However, in preparation for a planned ORP authorization basis inspection, BNI performed an internal Management Assessment of representative design basis documents (piping and instrumentation drawings and general arrangement drawings) to check conformance to the design as portrayed in the PSARs submitted in late 2001 to support authorization of construction of the LAW basemats and walls-to-grade for various facilities associated with the WTP. Inconsistencies were identified between descriptive and quantitative information in the PSARs, including design parameters used as inputs to safety analyses and evolved design details on current drawings.

BNI reported that for all cases identified, the design details incorporated appropriate safety requirements and features, but the appropriate change request to the authorization basis documents had not been submitted to ORP for approval. A full description of the discrepancy and immediate compensatory measures was provided to ORP in a letter dated October 18, 2002.[193]

In a BNI letter of October 30, 2002,[194] BNI made the following additional commitments to ORP to resolve the authorization basis maintenance issue:

- Perform 100% review of primary design drawings issued to date as Revision 0 or higher by cognizant ES&H analysts and design engineers. Reviews were to be completed by November 22, 2002.

- Modify procedures to mandate the use of a Screening Check List by November 11, 2002.

- Make changes to drawing, design criteria, and change control procedures to address descriptive text by November 22, 2002.

- Provide additional training to engineering management, supervision, and design engineers on the subjects of authorization basis content, authorization basis conformance, and authorization basis maintenance by December 2, 2002.

[193] CCN: 043667, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Authorization Basis Consistency," dated October 18, 2002.
[194] CCN: 042775, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Hanford Tank Waste Treatment and Immobilization Plant – Construction Authorization Readiness in Consideration of Recent Assessments and Inspections of Engineering Activities," dated October 30, 2002.

ORP performed a partial inspection of these commitments during a November 4-7, 2002, readiness inspection for full LAW and HLW facility construction authorization.[195] As of the date of the inspection, approximately 40% of the drawings had been reviewed and, while some inconsistencies were found, no instances were found where the design needed to be modified to achieve compliance with the safety basis described in the PCARs or PSARs.

During the November 4-7, 2002, readiness inspection, inspectors were provided a copy of a memorandum from the BNI Engineering Manager to all discipline managers, summarizing the results of the authorization basis management assessment and mandating the use of the Safety Screen Checklist. The inspectors were also provided a copy of a new procedure, 24590-WTP-GPP-SREG-009_0, *Safety Screening and Safety Evaluation*, dated November 4, 2002, which addressed use of the Safety Screen Checklist. The inspectors found that the new procedure provided a detailed checklist to be used by the engineers to ensure design changes were properly reviewed against requirements of the authorization basis.

Based on the November 4-7, 2002, readiness inspection, the inspectors determined that BNI had adequately evaluated the deficiencies associated with the authorization basis maintenance process, determined the extent of the conditions, determined the significance and impact the deficiencies might have on design, and begun to implement meaningful corrective actions.

To verify that all of the BNI commitments identified in the October 30, 2002, BNI letter have been completed, another readiness inspection will be performed by the ORP prior to authorization for construction of the full PT facility. This readiness inspection will be performed during January 2003 and, together with this SER, will form the basis for issuance of a Construction Authorization Agreement for full PT facility construction.

8. **Compliance with the Procedure Described in the SRD for Independent Review and Assessment of SRD Changes** – Independent review and assessment of changes to the SRD were described in the SRD, Volume I, Sections 3.6, "Maintenance of the SRD," and 4.0, "Maintenance of the SRD." However, with approval of ABCN 24590-WTP-ABCN-ESH-01-001,[196] to eliminate Volume I of the SRD, the requirements were moved to SRD Volume II, Appendix A, Section 11.0, "Maintenance Process," and 8.0, "Confirmation of Standards Process."

Each ABCN submittal listed the individuals who were required reviewers for the ABCN. Typically, several independent reviewers were required to concur with the ABCN. Besides the affected organization that generated the ABCN, review and signoff were required from the QA manager, the Project Safety Committee

[195] 02-OSR-0586, ORP letter R. J. Schepens to R. F. Naventi, BNI, "Inspection Report A-03-OSR-RRPWTP-002 – Construction Authorization Request Readiness Inspection," dated December 10, 2002.
[196] 02-OSR-0449, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Approval of Bechtel National Inc Authorization Basis Change Notices 24590-WTP-ABCN-ESH-01-001, Revision 1, 24590-WTP-ABCN-ESH-01-029, Revision 1, and Partial Approval of 24590-WTP-ABCN-ESH-02-019, Revision 0," dated October 3, 2002.

Chairman, the commissioning training manager, and the engineering manager on the ABCN submitted to ORP. The reviewers determined that this met the requirements for independent review of changes to the SRD.

6.3.3 Conclusions

The reviewers concluded that BNI's proposed changes to the SRD and ISMP were acceptable, and its design complied with the design related part of the updated SRD. However, there was insufficient information to conclude that BNI's ITS activities were being conducted according to its approved ISMP (and SRD).

The reviewers were unable to determine that BNI was compliant with the SRD and ISMP due to the incomplete verification that the weaknesses identified in this area in November 2002 had been corrected. (These weaknesses are described in Items 1, 2, 7, and 8 above.) In addition, the reviewers identified two additional conditions of acceptance (see below). The inspection to confirm that these weaknesses have been corrected will be performed in January 2003; and, along with this SER, will form the basis for issuing a Construction Authorization Agreement for full PT facility construction.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. BNI will implement the corrective actions specified in Attachment 2, "Assessment of the Effect of Design Process Implementation Issues on Construction Authorization Readiness," to the BNI letter dated October 30, 2002.[197] These corrective actions must be completed by the dates provided in the letter. (See Section 6.3.2, Item 1.)

2. BNI will perform a thorough assessment of the effectiveness of the engineering work performance improvement initiatives for all disciplines performing engineering design work, submit the assessment results, and identify any additional corrective actions deemed necessary before the first revision of the PSAR following authorization for full facility construction. (Section 6.3.2, Item 1.)

3. Update PSAR Volume I, *General Information*; Table 2-6, "Categorization of Piping"; Section 2.4.9, "Piping Design"; and Section 2.4.10, "Pipe Support Design," to be consistent with the SRD implementing standards for piping and pipe support design in the first revision of the PSAR after full facility construction authorization, as committed to in response to Question PT-PSAR-339. (See Section 6.3.2, Item 3[b].)

4. As a condition on the construction, BNI must retain the option to design and install automatic fire suppression for the affected areas and is not authorized to construct SSCs that implement control strategies that are inconsistent with meeting the current SRD

[197] CCN: 042775, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Hanford Tank Waste Treatment and Immobilization Plant – Construction Authorization Readiness in Consideration of Recent Assessments and Inspections of Engineering Activities," dated October 30, 2002.

requirements. This condition of acceptance excludes nine rooms in the HLW building, (per revised SRD Safety Criterion 4.5-4 and 24590-WTP-ABAR-ESN-03-008, *Modification of SRD Safety Criterion 4.5-4 to Allow Omission of Automatic Fire Suppression Systems from High Radiation Areas.* (See Section 6.3.2, Item 3[h].)

6.4 Revised Radiation Protection Program

The purpose of this review was to determine whether BNI's radiological protection program, *Radiation Protection Program (RPP) for Design and Construction*, as revised in ABCN 24590-WTP-ABCN-ESH-01-024,[198] *Radiation Protection Program (RPP) for Design and Construction*, Revision 1, and responses to Questions LAW-PSAR-213 and PT-PSAR-236, adequately addressed activities to be performed during the design and construction phases of the project, including preoperational testing and cold commissioning.

6.4.1 Requirements

BNI's radiological protection program is required to comply with 10 CFR 835.[199] Section C, Standard 7, Table S7-1 of the BNI Contract, requires a revised radiological protection program be submitted and approved at the start of construction. DOE/RL-96-0003, Section 4.3.2, "Contractor Input," Item F, further requires that a radiological protection program be submitted with the CAR.

BNI's radiological protection program, based on the requirements of 10 CFR 835, was acceptable if it was consistent with the SRD safety criteria in Section 5.0, "Radiation Protection." Review guidance on the radiological protection program was also provided in RL/REG-98-11, *Guidance for Review of the TWRS Privatization Contractor Radiation Protection Program Document Required by 10 CFR 835, Occupational Radiation Protection*.

6.4.2 Evaluation

The radiological protection program was systematically evaluated based on the review guidance to determine whether it complied with the applicable requirements of 10 CFR 835, sections of BNI's authorization basis documents, and the BNI Contract, as described above.

During the review, BNI proposed and DOE accepted minor editorial and typographical changes to the radiological protection program in ABCN 24590-WTP-ABCN-ESH-01-024, Revision 1. Revision 1 of 24590-WTP-ABCN-ESH-01-024 and the associated radiological protection program were approved on July 11, 2002.[200]

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[198] CCN: 030598, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Transmittal for Information: ABCN 24590-WTP-ABCN-ESH-01-024, Rev. 0, Radiation Protection Program (RPP) Document Number and Editorial Changes," dated May 22, 2002.
[199] RPP-WTP Contract, Section C, Standard 7, (e)(2)(ii).
[200] 02-OSR-0314, ORP letter from R. C. Barr to R. F. Naventi, BNI, "Office of Safety Regulation (OSR) Approval of Bechtel National, Inc (BNI) Authorization Basis Change Notice 24590-WTP-ABCN-ESH-01-024, Revision 1," dated July 11, 2002.

To confirm that the radiological survey commitments identified in the LCAR, Section 4.0 "Radiological Safety," were still in effect, the reviewers submitted questions LAW-PSAR-213 and PT-PSAR-236. In response, BNI reaffirmed the radiation safety commitment addressed in the LCAR for a radiological contamination control program for the WTP during all phases of design, construction, and preoperational testing. This program confirms that radiological conditions have not changed and ensures that if radioactive contamination is detected, it will be appropriately controlled. As stated in BNI's response, procedures that address construction site response to off-normal radiological conditions have been developed.

To protect the worker and the public, previous conditions from the Limited Construction Authorization Agreement, namely, "The radiological surveys, potential radiological contamination control and remediation activities, and the use of industrial radioactive sources as described in the LCAR, Section 4.0, 'Radiological Safety,'" will remain in effect in the Construction Authorization Agreement.

6.4.3 Conclusions

The reviewers determined that the *Radiation Protection Program for Design and Construction*, as revised by ABCN 24590-WTP-ABCN-01-024, Revision 1, continued to meet the review criteria established in the review guidance document, addressed all applicable requirements of 10 CFR 835, and contained acceptable measures for achieving compliance with the requirements, and therefore was acceptable.

6.5 Deactivation Safety Assessment Outline

The purpose of this review was to determine whether BNI's outline of the Deactivation Safety Assessment addressed the requirements specified in DOE/RL-96-0003.

6.5.1 Requirements

DOE/RL-96-0003, Section 3.3.6, "Authorization for Deactivation," contains the requirements for an outline of the Deactivation Safety Assessment, stating that "the purpose of the Authorization for Deactivation regulatory action is to authorize deactivation of the Contractor's facility following a stipulation by the Contractor to cessation of the waste processing activities at the facility." Section C, Standard 7, Table S7-1 of the BNI Contract, requires completion and submittal of an outline for a Deactivation Safety Assessment at the start of construction. In addition, RL/REG-99-05, Section L.3, "Outline of Deactivation Safety Assessment," provided review criteria.

The outline of the Deactivation Safety Assessment is acceptable if it covers aspects of deactivation that impact the safety of the facility and co-located workers, the public, and the environment. The goal of the Deactivation Safety Assessment is to ensure that deactivation operations can be performed in a manner that fully protects the facility and co-located workers, the public, and the environment while meeting applicable requirements and regulations.

The outline of the Deactivation Safety Plan should be similar to the structure of the Safety Analysis Reports being submitted by BNI for construction authorization and for production operations, except directed toward deactivation. Examples of sections that might be included (this is not an all-inclusive list, but rather an example) would be as follows:

1. Introduction

2. Facility description at start of deactivation (including the facility; heating, ventilating, and air conditioning [HVAC] systems; sprinkler systems; and criticality alarm system)

3. Activity description at start of deactivation (including general facility operations, radioactive waste handling, nonradioactive hazardous material handling, deactivation, and nonhazardous facility operations)

4. Safety management programs in place for deactivation (including ISM, criticality safety, radiation protection, hazardous material protection, radioactive and hazardous material management, operational safety, activity control, procedures and training, QA, emergency preparedness, and institutional safety provisions)

5. Hazards identification and assessment for the deactivation approach

6. Deactivation accident analysis summary (including safety analysis approach, risk classification methodology, NPHs, bounding postulated accident scenarios, and safety analysis assumptions)

7. Hazard control strategies during deactivation

8. Description of final radiation survey to be performed

9. Proposed schedule for deactivation

10. Summary and conclusions.

6.5.2 Evaluation

The reviewers evaluated the outline of the Deactivation Safety Assessment submitted January 25, 2002,[201] against the applicable criteria defined in RL/REG-99-05 and found it to be acceptable. The outline indicated that the objectives of protecting the facility and co-located workers, the public, and the environment during deactivation will be adequately addressed in the Deactivation Safety Assessment. The outline indicates the Deactivation Safety Assessment will most likely be a revision of the FSAR and will include the following:

[201] CCN: 026384, BNI letter from A. R. Veirup to M. K. Barrett, ORP, "Contract Deliverables due with Construction Authorization Request for the Hanford Waste Treatment and Immobilization Plant," dated January 25, 2002.

1. A facility-specific executive summary that introduces the differences in facility design from that presented in the FSAR; identifies the planned administrative controls to be implemented; and concludes the SRD requirements and commitment to adequately protect the public, the facility and co-located workers, and the environment will be achieved

2. A brief description of the WTP site as it exists at the end of production operations as necessary to support the hazard and accident analysis

3. A description of the facilities sufficient to continue waste processing that would allow deactivation to proceed and the ability of those facilities to withstand NPHs hazards

4. Identification of the hazard and accident analysis appropriate to deactivation and a description of the control strategies

5. A description of the SSCs applicable to deactivation and any additional SSCs that might be added to support deactivation

6. Identification of TSRs necessary to support deactivation

7. A discussion of what, if any, criticality control measures are necessary

8. A description of the radiation protection program, hazardous material protection programs, and radioactive and hazardous waste management programs

9. A summary of the acceptance criteria, preoperational testing, and evaluation of results of equipment installed specifically to support deactivation

10. The CONOPS, procedures, and training programs necessary to support deactivation

11. Human factors; QA; fire protection; emergency management; and management, organizational and institutional safety provisions to support deactivation

12. Reference to the WTP *Deactivation Plan*, 24590-WTP-PL-01-007, that will include the facility final radiation survey, characterization plans, and schedule commitments.

6.5.3 Conclusions

The reviewers concluded that outline of the Deactivation Safety Assessment was acceptable. The outlines included the status of the facility at the start of deactivation, the safety management programs that will be in place for deactivation, the hazards analysis for the deactivation approach, the controls that will be imposed for deactivation, the approach for handling deactivation wastes, and references the Deactivation Plan that describes the final radiation survey of the facilities and the schedule for deactivation.

6.6 Design Data and Design Drawings

The purpose of this review is to determine whether BNI submitted design data and drawings in a timely manner to support the description of facility SSCs, including those designated as ITS.

6.6.1 Requirements

DOE/RL-96-0003, Section 4.3.2, "Contractor Input," provides the requirements for design data and design drawings, stating, "The CAR submittal package shall consist of the following documentation: A PSAR containing the following: Design data and design drawings to support the description of facility structures, systems, and components including those designated as important to safety." In addition, RL/REG-99-05, Section M, "Design Data and Design Drawings," provided the following review criteria:

1. "BNI submitted or made available promptly and conveniently, as necessary, the appropriate design data for the CAR reviewers. The design data may be controlled but must be readily accessible to reviewers either in a controlled facility provided by BNI or controlled by the OSR.

2. BNI submitted or made available, as necessary, the appropriate design drawings for the CAR reviewers. The design drawings may be controlled but should be readily accessible to the CAR reviewers either in a controlled facility provided by BNI or controlled by the OSR."

6.6.2 Evaluation

Design data and drawings were not provided in a timely manner to support the basemat PCAR and walls to grade PSAR reviews. This deficiency was worsened by errors in the submittals and requests for changes to the standards that had not been integrated with the submittals. While some of the design data and design drawings were submitted to ORP with the LAW and HLW PCAR and PSAR submittals, much of the design data and calculations were not available until late in the review process, primarily because they had not been completed. This problem was identified early by ORP but persisted through the LAW and HLW full facility final review and the PT final review.

The delay in receiving design data and calculations was particularly true for the structural characteristics of the three facilities. The review of preliminary calculations and drawings, which were revised frequently during the overall review, required the reviewers to expend considerably more time to review the BNI submittals than was originally planned when the segmented review concept was accepted. While the reviewers ultimately were able to perform most of the detailed review of most parts of the BNI submittals, final review was not completed until mid October 2002 for the HLW facility and mid December 2002 for the PT facility.

Similarly, the review of hazard and accident analyses required more resources than planned because of extensive inconsistency and ambiguity in the PSAR and because of its complicated segmentation.

6.6.3 Conclusions

Notwithstanding the deficiencies described above, the reviewers concluded that, with the conditions to rectify the deficiencies identified in documentation described in the SER, and the additional design data and drawings referred to in the SER, the design data and drawings were acceptable.

6.7 Closure of Open Items from Previous Reviews

The purpose of this review is to determine whether BNI submitted sufficient design data and other information to support the closure of open items from previous ORP safety reviews.

6.7.1 Background

On January 12, 1998, an Initial Safety Assessment was submitted to DOE by BNFL Inc., the predecessor Contractor to BNI. DOE evaluated the Initial Safety Assessment submittal in an SER dated March 27, 1998,[202] and provided BNFL a list of open issues. BNFL provided the status of these issues in a letter to DOE dated April 7, 1999.[203] To assist in resolving the open items before the CAR was submitted, a series of Topical Meetings were held between BNFL and DOE. These meetings resulted in resolution of some of the open issues, and the generation of other open issues, termed "significant unresolved issues," as well as Topical Meeting open items. As part of the transition to a new Contractor, these significant unresolved issues and the Topical Meeting open items were transmitted to BNI on January 31, 2001,[204] for followup and closure before the CAR was issued. In all, 210 items remained open from previous ORP safety reviews and were tracked to closure.

6.7.2 Evaluation

ORP reviewed all the open issues in the Initial Safety Assessment and from the Topical Meetings and closed 204 of the 210 open issues in an internal ORP memo, 02-OSR-0493, "Closeout of Open Items from Topical Meetings and the Initial Safety Assessment (ISA) Review," dated October 15, 2002. The remaining 6 open issues, shown in Table 5 do not affect construction

[202] RL/REG-98-09, *DOE Regulatory Unit Initial Safety Evaluation Report of the BNFL Inc. ISA Package*.
[203] Ref. No. 002283, letter, M.J. Bullock, BNFL, to D.C. Gibbs, DOE, "Initial Safety Evaluation Report Open Issues and Questions – Status," dated April 7, 1999.
[204] 01-OSR-0021, ORP letter from W. J. Taylor to R. F. Naventi, BNI, "DOE Plan to Evaluate Bechtel National, Inc. (BNI) Capability to Change the River Protection Project Waste Treatment Plant Authorization Basis," dated January 31, 2001.

Table 5. Open Items from Initial Safety Analysis Report (ISAR) Review and Topical Meetings

Source	Issue Number	Issue	Closure Commitment
ISAR	C-17	Establishment of an "at the controls" area in the main control room, or of limiting access to the main control room only to authorized personnel (Section 3.9.3.11, "Operational Practices")	FSAR – Applicable to all facilities with control rooms
ISAR	C-27	Inconsistencies between information provided in the USQ Plan outline and SRD Safety Criterion 7.4-4	FSAR – Applicable to all facilities
ISAR	Q-011	Sample results	PSAR for Analytical Labs
ISAR	Q-012	Details regarding sample isolation and shielding as well as methods, controls, equipment, and worker protection	PSAR for Analytical Labs
Topical Meeting	TMAI-18-12	Discuss ALARA and RAMI used in the melter subsystems	FSAR – Applicable to LAW and HLW facilities
Topical Meeting	TMAI-7	Specify laboratory data quality requirements	PSAR for Analytical Labs

authorization activities associated with the LAW, HLW, and PT facilities and will be closed as part of the Analytical Laboratory SER, or as part of the FSAR process.

6.7.3 Conclusions

Initial Safety Assessment open issues, Topical Meeting significant unresolved issues, and Topical Meeting open action items that pertain to construction authorization for the LAW, HLW, and PT facilities have been adequately addressed and closed through the PSAR review process. Open issues associated with construction authorization of the PT facility, as shown in Table 5 will be closed as part of the Analytical Laboratory SER, or as part of the FSAR process.

7.0 RECOMMENDATIONS

7.1 LAW Facility

Authorization for construction of the LAW facility was done in three phases: basemat, walls to grade, and full facility. Each is discussed in the following sections.

7.1.1 Basemat

Construction authorization was requested for the following specific activities related to the LAW facility basemat:

- Installing the FRE for the LAW basemat
- Installing the ground grid connections to LAW basemat rebar
- Placing the LAW basemat concrete
- Backfilling the LAW basemat.

Based on the detailed review performed by the OSR between December 19, 2001, and June 25, 2002, the OSR concluded that the construction of the LAW facility basemat and other activities listed above should be approved subject to the conditions of acceptance listed in Appendix B. Backfilling the LAW basemat was not discussed in the LAW PCAR (Volume III). However, approval of backfill was authorized based on the approved process used for the Limited Construction Authorization Agreement.

7.1.2 Walls to Grade

Construction authorization was requested for the following specific activities related to the LAW facility walls to grade:

- Installing the FRE for internal and external structural concrete walls

- Placing concrete from -21 foot elevation up to nominal grade elevation (+3 foot maximum).

Based on the detailed review performed by the OSR between February 14, 2002, and July 31, 2002, the OSR concluded that the construction of the LAW facility walls to grade as listed above should be approved subject to the conditions of acceptance listed in Appendix B. Backfilling the LAW walls to grade was not discussed in the LAW PCAR (Volume III). However, approval of backfill of the walls to grade was authorized based on the approved process used for the Limited Construction Authorization Agreement.

7.1.3 Full Facility

Construction authorization was requested for construction of the remaining portions of the LAW facility. Based on the detailed review performed by the OSR between December 19, 2001, and November 13, 2002, the OSR concluded that construction of the full LAW facility should be approved subject to the conditions of acceptance listed in Appendix B.

7.2 HLW Facility

Authorization for construction of the HLW facility was done in three phases: basemat, walls to grade, and full facility. Each is discussed in the following sections.

7.2.1 Basemat

Construction authorization was requested for the following specific activities related to the HLW facility basemat:

- Installing the FRE for the HLW basemat
- Installing the ground grid connections to HLW basemat rebar
- Placing the HLW basemat concrete
- Backfilling the HLW basemat.

Based on the detailed review performed by the OSR between December 19, 2001, and June 25, 2002, the OSR concluded that the construction of the HLW facility basemat and other activities listed above should be approved subject to the conditions of acceptance listed in Appendix B. Backfilling the HLW basemat was not discussed in the HLW PCAR (Volume IV). However, approval of backfill was authorized based on the approved process used for the Limited Construction Authorization Agreement.

7.2.2 Walls to Grade

Construction authorization was requested for the following specific activities related to the HLW facility walls to grade:

- Installing the FRE for internal and external structural concrete walls FRE

- Placing concrete from -21 and -31 foot elevations up to nominal grade elevation (+3 foot maximum).

Based on the detailed review performed by the OSR between March 5, 2002, and August 15, 2002, the OSR concluded that the construction of the HLW facility walls to grade as listed above should be approved subject to the conditions of acceptance listed in Appendix B. Backfilling the HLW walls to grade was not discussed in the HLW PCAR (Volume IV). However, approval of

backfill was authorized based on the approved process used for the Limited Construction Authorization Agreement.

7.2.3 Full Facility

Construction authorization was requested for construction of the remaining portions of the HLW facility. Based on the detailed review performed by the OSR between December 19, 2001, and November 13, 2002, the OSR concluded that the construction of the full HLW facility should be approved subject to the conditions of acceptance listed in Appendix B.

7.3 PT Facility

Approval of construction of the PT facility is planned to be given in two segments: (1) pits, tunnels, and basemat, and (2) full facility.

7.3.1 Pits, Tunnels and Basemat

Construction authorization was requested for the following specific activities associated PT facility pits and tunnels:

- Constructing pits and tunnels
- Installing the subgrade structural concrete pit and tunnel floor and wall FRE
- Placing the concrete from -45-foot elevation up to nominal grade elevation
- Installing the FRE for the PT basemat
- Installing the ground grid connections to PT basemat rebar
- Placing the PT basemat concrete
- Backfilling pits, tunnels, and basemat excavation.

Based on the detailed review performed by the OSR between May 1, 2002, and November 13, 2002, the OSR concluded that the construction of the PT facility pits, tunnels, and basemat as described above should be approved subject to the conditions of acceptance listed in Appendix B. Backfilling of the PT pits, tunnels, and basemat excavation was not discussed in the PT PSAR (Volume II). However, approval of backfill is authorized based on the approved process used for the Limited Construction Authorization Agreement.

7.3.2 Full Facility

Construction authorization was requested for construction of the remaining portions of the PT facility. Based on the detailed review performed by the OSR between May 1, 2002, and March 17, 2003, the OSR concluded that a recommendation to approve construction of the full PT facility was premature due to the considerations in Section 6.3 of the SER (incomplete assurance that activities are being conducted according to the ISMP [and SRD]). In all other respects the

approval of construction of the PT facility is recommended subject to the conditions in Appendix B.

7.4 Balance of Facilities

Approval of construction on the BOF is planned to be done based on sequential review for specific requests from BNI.

7.4.1 BOF-1 and BOF-2

Construction authorization was requested for the following specific BOF activities:

- Electrical utility distribution systems
- Switchgear building
- BOF switchgear building
- ITS switchgear building
- Administration building
- Chiller/compressor building
- Water treatment building and storage tanks
- Cooling tower facility
- Fire water pump house and fire water storage tanks
- Nondangerous, nonradioactive liquid effluent facility
- Access control facility
- Simulator facility, located off site
- Warehouse
- Steam plant
- Wet chemical storage facility
- Diesel generator facility (includes both standby and EDGs)
- Fuel oil facility
- Melter assembly building.

Based on the detailed review performed by the OSR between February 19, 2002, and November 13, 2002, the OSR concluded that the construction of the specific portions of the BOF described above should be approved subject to the conditions of acceptance in Appendix B.

The glass former storage facility will be added to the PSAR list of BOF structures by contractor-approved ABCN 24590-WTP-ABCN-ESH-02-020, which was transmitted to ORP on December 26, 2002.[205] The ABCN documented that there were no ITS SSCs in the glass former storage

[205] CCN: 035820, BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Transmittal for Information: Authorization Basis Change Notice 24590-WTP-ABCN-ESH-02-020, Revision 0, Change to an AB Document – Revision to the BOF PSAR Adding Facilities/Systems to the Construction Authorization Request," dated December 26, 2002.

facility. The transmittal letter also stated that a planned BOF-4 submittal would not take place. The planned submittal was to request construction of an encapsulation facility, waste buildings, and a melter assembly building; however, these building were being deferred.

8.0 REFERENCES

10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements," *Code of Federal Regulations*, as amended.

10 CFR 830.206(b), "Preliminary documented safety analysis," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

10 CFR 835.703, "Other Monitoring Records," *Code of Federal Regulations*, as amended.

10 CFR 835.704b, "Administrative Records," *Code of Federal Regulations*, as amended.

29 CFR 1910.38, "Employee emergency plans and fire prevention plans," *Code of Federal Regulations*, as amended.

29 CFR 1910.119, "Occupational Safety and Health Act of 1970, Process Safety Management of Highly Hazardous Chemicals," *Code of Federal Regulations*, as amended.

29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations*, as amended.

40 CFR 355, "Emergency Planning and Notification," *Code of Federal Regulations*, as amended.

40 CFR 68, "Chemical Accident Prevention Provisions," *Code of Federal Regulations*, as amended.

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American Institute of Chemical Engineers (AIChE), *Guidelines for Hazard Evaluation Procedures, Second Edition with Work Examples*, AIChE, Center for Chemical Process Safety, New York, 1992.

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9.0 LIST OF TERMS

AB	authorization basis
ABCN	authorization basis change notice
ACI	American Concrete Institute
AIChE	American Institute of Chemical Engineers
ALARA	as low as reasonably achievable
BARCT	best available radionuclide control technology
BNI	Bechtel National, Inc.
BOF	Balance of Facility
CAR	Construction Authorization Request
CM	configuration management
CONOPS	Conduct of Operations
CSD	control strategy development
CSER	Criticality Safety Evaluation Report
CSL	critical safety limit
D&D	deactivation and decommissioning
DBE	design basis event
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DWPA	Dangerous Waste Permit Application
EDG	emergency diesel generator
EIS	environmental impact statement
ERPG	Emergency Response Planning Guidelines
ERPP	Environmental Radiological Protection Program
ES&H	environment, safety, and health
FRE	forms, rebar, and embedments
FSAR	Final Safety Analysis Report
HLP	HLW lag storage and feed blending process
HLW	high-level waste
ISAR	Initial Safety Analysis Report
ISM	integrated safety management
ISMP	Integrated Safety Management Plan
ITS	important-to-safety
LAW	low-activity waste
LCAR	Limited Construction Authorization Request
M	Molar
MIP	Maintenance Implementation Plan
myp	mil per year
NCS	nuclear criticality safety
NFPA	National Fire Protection Association
NPH	natural phenomena hazard
NRC	U.S. Nuclear Regulatory Commission
OAR	Operating Authorization Request
ORP	Office of River Protection
OSR	Office of Safety Regulation
PC	performance category
PCA	Portland Cement Association

PCAR	Partial Construction Authorization Request
PFHA	Preliminary Fire Hazard Analyses
PSAR	Preliminary Safety Analysis Report
PT	pretreatment
QA	quality assurance
QAM	Quality Assurance Manual
Rad NOC	Radioactive Air Emissions Notice of Construction
RCM	Radiological Control Manual
RCP	Radiological Control Program
RPP	River Protection Project
RWP	Radiation Work Permit
SASSI	System for Analysis of Soil Structure Interaction
SAT	systematic approach to training
SC	seismic category
SDC	safety design class
SDS	safety design significant
SER	safety evaluation report
SIPD	Standards Identification Process Database
SL	severity level
SRD	Safety Requirements Document
SSC	system, structure, and component
SSI	soil-structure interaction
TSR	technical safety requirement
TWINS	Tank Waste Information Network System
TWRS	Tank Waste Remediation System
UPS	uninterruptible power system
USQ	Unresolved Safety Question
WDOH	Washington State Department of Health
WTP	Waste Treatment and Immobilization Plant

Appendix A - Review Team

Table A.1 summarizes the review team's composition and expertise for review of BNI's PCAR and PSAR submittals.

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Table A.1. Review Team Membership Education and Experience

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
George Abatt	B.S. and M.S., Engineering Mechanics, Michigan State University; Ph.D., Theoretical and Applied Mechanics, University of Illinois at Urbana-Champaign. Over 13 years experience in structural analysis seismic analysis, soil-structure interaction analysis, dynamics, and finite element analysis of structures.		X			
Jim Adams	B.S., Nuclear Engineering, Texas A&M University. Over 30 years experience related to nuclear operations and oversight of nuclear operations. Qualified as an ANSI Level III Test Engineer and a Senior Reactor Operator. Expertise in conduct of operations.	X	X			
Mike Black	B.S., Geological Engineering, University of Idaho. Over 28 years experience in ground support and excavation, including both mining and civil applications. Experience with drill and blast, ripping, scrapers, power shovels, and front-end loaders on jobs ranging from striping operations for open pit mining to basement excavations for residential homes.					
Jay Boudreau	Ph. D., Engineering, University of California at Los Angeles. Over 30 years experience in nuclear reactor design, safety, fuel cycle technology and economics, waste management, and mission and systems analysis for NASA and the U.S. Department of Defense (DOD) nuclear power applications (terrestrial and space). Instrumental in helping the OSR establish and implement the WTP regulatory program.	X	X	X		
Pat Carier	B.S., Mechanical Engineering, Penn State University; Master's in Management, University of Phoenix. OSR Verification and Confirmation Official. Senior reactor operator certification; QA training and facilitating. More than 16 years experience in nuclear power licensing and system integration, regulatory affairs, and QA.					
Bruce Carpenter	B.S., Architectural Engineering, University of Colorado; M.S., Civil Engineering, Structures, Stanford University. Registered professional engineer with over 15 years experience on commercial and DOE projects. Expertise in structural engineering and seismic design for structural steel and reinforced concrete.			X	X	
Ko Chen	B.S., Chemical Engineering, National Taiwan University; Ph.D., Mechanical Engineering, University of California Berkeley. Licensed mechanical engineer. More than 20 years experience in nuclear safety, fluid mechanics, mass transfer, and heat transfer.	X	X	X	X	
Tony Chung	B.S.M.E., Taiwan Chung-Hsing University, M.S.M.E., Washington State University. Licensed structural engineer. Over 25 years engineering experience, including over 17 years in structural and thermal analysis.	X	X			

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Dick Cooper	B.S. Marine Engineering, U.S. Naval Academy, Masters Program (non-degreed), Radiation Health Physics, Georgetown University. QA lead auditor certification through Consolidated Edison. Over 30 years experience in nuclear power, including constructing, designing, operating, regulating, and providing safety oversight. Over 13 years with the NRC.	X	X			
James Cunnane	Ph.D., Nuclear Radiochemistry, Purdue University. Over 20 years experience in radioactive waste processing, evaluation of waste forms, vitrification of radioactive wastes, and radiochemistry.		X			
Dean Davis	B.S., University of Montana. Certified professional engineer in fire protection. Over 45 years experience in fire protection, including 14 years with DOE Richland Operations, and 15 years as Chief, Fire Protection, U.S. Army, Europe.	X	X	X		
Bob Defayette	B.A., Chemistry, St. Ambrose College; M.S., Physical Chemistry, Iowa State University. Over 35 years experience in the nuclear field with the NRC, DOE, and nuclear utilities. Extensive experience in assessing operational performance, QA programs, employee safety concerns, corrective action programs, and emergency preparedness.	X	X			
Richard Evans	B.A., Mathematics, Pomona College; B.S., Air Conditioning and Refrigeration, California Polytechnic Institute. Licensed professional engineer. Over 40 years experience in HVAC design and engineering, control systems, and mechanical systems.			X		
Vic Ferrarini	B.S.M.E., University of Massachusetts at Dartmouth; M.S.M.E., University of Rhode Island. Registered professional engineer. Over 30 years experience in designing, analyzing, inspecting and auditing piping, pipe supports, pressure vessels, valves, pumps, and other mechanical components, including heat transfer and fatigue analysis of ASME (American Society of Mechanical Engineers) Class I components.	X	X			
Rick Garrison	B.S., Electrical Engineering, Washington State University. More than 17 years experience in systems engineering, design, installation, startup, operations, and maintenance of instrumentation, control, power, and data management systems at DOD and DOE facilities.		X			
Yvonne Gibbons	B.S., Civil Engineering, Arizona State University; M.S., Civil Engineering, Old Dominion University. More than 10 years experience in foundation design, geotechnical investigations and analysis, environmental investigations and analysis, slope stability analysis, and seismic analysis.					
Rob Gilbert	B.S., Metallurgical Engineering, University of Washington. Five years nuclear Navy and 10 years experience in waste vitrification technology and design, Hanford tank waste storage and treatment system design, and pressure vessel steel material performance.	X	X	X	X	

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Robert Griffith	B.S., Mechanical Engineering, University of Arizona; M.S., Mechanical Engineering, Stanford University. Registered professional engineer. More than 26 years experience in systems engineering, licensing support, safety engineering, and environmental qualification at DOE, commercial power plants, and the Savannah River Site.		X		X	
Ann Hansen	B.S., Mathematics and Physics, Florida Southern College; M.S., Physics, Virginia Polytechnic Institute; M.S., Nuclear Engineering, Carnegie Mellon University. Over 25 years experience in hazard and accident analyses, safety analysis report development, and technical safety requirement development and analysis.	X	X	X	X	
Al Hawkins	B.S., Chemical Engineering, University of Washington; MBA, Operations Research, Washington State University. OSR Openness Coordinator. More than 27 years experience in operations, oversight, safety, and QA. Former manager of Compliance Assurance and Director of Environment, Safety, Health and Quality Assurance at WHC.	X	X			
Quazi Hossain	B.S., Civil Engineering, Bangladesh University of Engineering & Technology; M.S., Structural Engineering, Texas A&M University; Ph.D., Structural Engineering, University of California, Davis. Licensed civil engineer. Fellow, American Society of Civil Engineers. Over 35 years experience in structural and seismic engineering, safety system classification, and safety design and analysis.	X	X	X		
Neal Hunemuller	B.S., Nuclear Engineering, Iowa State University. Certified NRC Operator Licensing Examiner; Licensed NRC senior operator; NRC-certified incident investigation team member. More than 20 years experience in commercial nuclear power and the NRC. Expertise in standards identification process, conformance/compliance reviews, and training and qualifications.	X				
Ninu Kaushal	B.A., B.S., and M.S. in Physics, Punjab University; MBA, Northern Illinois University; Ph.D., Nuclear Physics, Rensselaer Polytechnic Institute. More than 20 years experience in the commercial nuclear industry in nuclear physics, nuclear safety evaluations, nuclear criticality, electrical design, and instrument and controls; 10 years experience in nuclear research applying state-of-the-art instrumentation techniques.	X				
Bill Kennedy	B.S., Nuclear Engineering, Kansas State University; M.S., Nuclear Engineering, Kansas State University. Over 25 years experience in environmental and health physics. Nationally and internationally recognized expert in environmental radiological controls, environmental assessment, environmental regulations, radiation dosimetry, environmental pathway analysis, safety assessment and risk analysis, radiation shielding, health physics, and statistical analysis.	X	X			

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Dennis Kirsch	B.S. and M.S., Electrical Engineering, Montana State University. Registered Professional Engineer. More than 23 years with the NRC including position as Division Director of Reactor Safety and Projects; 5 years commercial experience. Expertise in mechanical and electrical construction inspection, power reactor operations, QA, and preoperational testing of mechanical and electrical systems.					
James Leivo	B.S., Electrical Engineering, Carnegie-Mellon University. Registered professional engineer. Over 30 years experience in the nuclear power industry and related energy systems, including instrumentation, control, and electrical and computer systems for nuclear power plants and DOE facilities. Has provided independent consulting services to NRC for operating, pre-operating, and advanced reactor plants.			X	X	
Ron Lerch	B.A., Chemistry, Pacific Lutheran University; Ph.D., Inorganic Chemistry, Oregon State University. More than 30 years experience in nuclear waste management, nuclear technology development, nuclear fuel reprocessing, environmental cleanup, and project management; 2 years as Deputy Manager of Hanford tank farms.	X	X	X	X	
Barclay Lew	B.A., Mathematics, and B.S., Nuclear Engineering, University of California, Santa Barbara; M.S., Engineering; Ph.D., Nuclear Engineering, UCLA. Over 28 years experience in nuclear safety analysis, heat transfer, mass transfer and fluid flow, computational fluid dynamics, and analysis of safety analysis reports.	X	X	X	X	
Ron Light	B.A., Mathematics, and M.B.A., University of South Dakota. Over 30 years of experience in management systems, business management, program controls, and financial management. Regulatory process administrator in OSR.	X				
Chung-King Liu	B.S., Zoology, Fu-Jen Catholic University (Taiwan); M.S., Chemistry, Kansas State College - Pittsburgh; Ph.D., Nuclear Radiochemistry, University of Arkansas. NQA-1 lead nuclear auditor. Over 23 years experience in nuclear waste management, radiochemistry laboratory management, and environmental cleanup. Expertise in the areas of chemical process safety, nuclear process safety, and health physics.	X	X	X		
Surya Maruvada	Master of Engineering, Electrical Power Engineering/Indian Institute of Science. Licensed professional engineer. Over 30 years experience in nuclear safety and hazard analyses, probabilistic risk assessment, reliability, availability, and maintainability analyses, and electrical power and control systems.	X	X	X		

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Omar Mazzoni	B.S., Electrical Engineering/Mechanical Engineering, National Litoral University (Argentina); M.S., Electrical Engineering, Polytechnic Institute of Brooklyn; D.Sc. Electrical Engineering, George Washington University. Certified professional engineer. Over 30 years experience in electrical engineering, high- and low-voltage power, instrumentation and control, and functional design reviews.					
Steve Merwin	B.S., Environmental Engineering, Northwestern University; M.S., Health Physics, Colorado State University. Certified health physicist and certified industrial hygienist. Over 15 years experience in health physics, risk assessment, and accident analysis.			X		
Ellen Messer-Wright	B.S., Electrical Engineering, University of New Mexico; M.S., Environmental Science, Washington State University. Certified health physicist. Over 10 years experience in occupational radiation protection, ALARA, and radiological compliance assessments.	X	X	X	X	
Milon Meyer	B.S., Mechanical Engineering, University of Iowa. Over 35 years experience in structural analysis, equipment qualification, and finite element analysis related to nuclear, gas turbine, rockets, and aerospace.	X	X	X	X	
Lew Miller	B.S., Physics, Massachusetts Institute of Technology; M.S., Nuclear Engineering Science, University of California, Berkeley. OSR Safety and Standards Review Official. Certified license examiner, senior resident inspector. More than 29 years experience with the nuclear Navy and the NRC. Expertise in nuclear safety oversight, safety analysis reviews assessments, and incident investigations.	X	X	X	X	
Matt Moeller	A.B., Mathematics, Cornell University; M.S., Environmental Health Physics, Harvard University. Certified health physicist. Over 20 years experience in health physics, radiation protection, industrial safety and hygiene, risk assessment, and emergency preparedness.	X	X	X		
Joe Panchison	B.S., Mechanical Engineering, Drexel University. Licensed professional engineer. Over 23 years experience in mechanical engineering design, thermal hydraulic analysis, fluid systems analysis, HVAC, power piping, and nuclear component codes and standards. Direct experience in plant modifications and configuration management.		X	X	X	
Keith Parkinson	B.S., Electrical Engineering, Purdue University. Certified reactor operator. Over 35 years experience in the nuclear field, including 24 years in the nuclear Navy and 10 years as an NRC inspector and NRC operator license examiner. Expertise in training, fire protection, operations, and electrical distribution systems.	X	X			

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Walter Pasciak	B.S., Physics, New York University; M.S., Nuclear Engineering, The Catholic University of America; Ph.D., Environmental Engineering, John Hopkins University. Over 28 years experience in nuclear power involving environmental, radiological, and safety oversight; 27 years with the NRC.					
Michael Plunkett	B.S.M.E., Mechanical Engineering, University of New Haven; M.S.M.E., Mechanical Engineering, University of Rhode Island. Licensed professional engineer. Over 29 years experience in designing, analyzing, inspecting, and auditing piping, pipe supports and other mechanical components in the power industry, fire protection, and NRC audits.	X	X			
Jeanie Polehn	B.S., Nuclear Engineering Technology, Oregon State University; M.S., Health Physics, Georgia Institute of Technology. Certified health physicist. Registered Environmental Manager. More than 20 years experience in radiation protection including occupational, environmental, and emergency response at commercial power plants and with DOE.	X	X	X		
Ross Potter	B.S., Nuclear Engineering, University of New Haven; M.S.M.E., Mechanical Engineering, University of Rhode Island. Licensed professional engineer. Over 29 years experience in designing, analyzing, inspecting, and auditing piping, pipe support, and other mechanical components in the power industry, fire protection, and NRC audits.	X	X	X		
Gerald Ritter	B.A., Chemistry, Pacific Lutheran University; B.S., Chemical Engineering, University of Washington; M.S., Chemical Engineering, University of California, Berkeley. Over 33 years experience in nuclear fuel fabrication and processing, nuclear waste management, and preparation and evaluation of safety analysis reports		X	X	X	
Grant Ryan	B.S., Physics, Frostburg State University; B.S., Nuclear Engineering, University of Maryland. Licensed professional engineer. Over 11 years experience in probabilistic risk analysis, radiological and toxicological consequence analysis, hazard analysis, and control selection methodologies.		X	X		
Jean Savy	Ph.D., Civil-Geophysics, Stanford University. Licensed civil engineer. Over 25 years experience in hazard analyses, risk analyses, and structural safety. Experience in seismic, tornado, and flood methodology development for probabilistic analyses.					
Ken Scown	B.S., Management Science, California State University, Hayward. Over 18 years nuclear fire protection auditing and consulting, including inspections for fire protection, emergency planning, and security. Worked 7 years fighting fires, servicing equipment, and training fire fighters; worked 6 years as a health and safety technician.	X	X			

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Vern Severud	B.S., Civil Engineering, California State University-Chico; M.S., Civil Engineering, University of Arizona. Licensed professional engineer. Fellow of American Society of Mechanical Engineers. Over 40 years experience in seismic design and analysis, and elevated temperature design and analysis.	X	X			
William Sherbin	B.S., Mechanical Engineering, Bucknell University; M.S., Mechanical Engineering, University of Maryland. Registered professional engineer. Over 30 years experience in heat exchange, fluid systems, ventilation systems, and seismic design requirements. Participant in over 40 nuclear power plant safety system functional inspections.		X	X	X	
Michael Shlyamberg	B.S.M.E., Polytechnic Institute, Lvov, USSR. Registered professional engineer. Over 20 years experience in design of nuclear safety support systems, thermal hydraulic calculations, safety evaluations, containment analysis, and preparation of safety analysis reports. Participant in over 45 NRC inspections and utility assessments.					
Bob Smoter	U.S. Navy Nuclear Power School. Over 20 years experience in commercial and DOE nuclear regulatory development, safety analysis reports, licensing, project management, and nuclear plant operations and maintenance.	X	X			
Allan Stalker	B.S., Chemistry, Idaho State University; M.S., Chemistry, Carnegie Institute of Technology; Ph.D., Chemistry, Carnegie-Mellon University. Over 40 years experience in the nuclear industry with expertise in nuclear chemistry, nuclear safety, spectroscopy, hazardous chemical analysis, and safety analyses.		X			
Robin Sullivan	B.S., Mechanical Engineering, University of Washington. Over 10 years experience in hazard analysis, risk assessment, safety licensing review, authorization basis development and maintenance, and regulatory compliance reviews.		X			
Mark Summers	B.S., Civil Engineering, Walla Walla College; M.S., Civil Engineering, Oklahoma State University. Over 21 years experience in structural engineering on various U.S. Army Corp of Engineer projects.	X	X			
Cindy Taylor	B.A., Business Management, Eckerd College; M.B.A., Engineering Management and Technology, City University. ANSI/ASME NQA-1 lead auditor. Over 13 years experience in QA program development and project management. QA support to DOE, NRC, OCRWM, and DOD-regulated projects.	X	X			
Susan Thraen	B.S., Nuclear Engineering, Pennsylvania State University. Over 17 years experience, including 6 with the NRC in regulatory process, nuclear facility design, construction, and operations. Expertise in safety analysis, radiation protection, emergency preparedness, regulatory compliance, and conduct of operations.	X	X	X		

Review Team Member	Education and Experience	Areas of Review				
		LAW	HLW	PT	BOF	Anal. Lab
Russ Treat	B.S., Chemical Engineering, Washington State University. Over 30 years experience in chemical and process engineering including nuclear waste management, processing of nuclear waste, and development of waste vitrification processes.	X	X	X		
James Troske	B.S., Electrical Engineering, Gonzaga University; M.S., Electrical Engineering, Montana State University. Licensed professional engineer. Over 30 years experience in electrical and control system engineering.		X			
Brian Vonderfecht	Ph. D., Nuclear Physics, Washington University. Over 11 years nuclear experience in the areas of nuclear criticality safety, accident analysis, probabilistic risk analysis, radiation shielding, and nuclear physics. Expertise in thermal-hydraulics, heat-transfer, diffusion, and chemical or thermal explosions.	X	X	X		
Frank Wenslawski	B.A., Physics, Rutgers University. Over 35 years of nuclear experience, including various management assignments in the U.S. Atomic Energy Commission, DOE, NRC, and the International Atomic Energy Agency. Expertise in radiation protection and emergency preparedness.					
Bob Winkel	B.S. and M.S., Civil Engineering, Brigham Young University; Ph.D., Structural Engineering, University of Colorado. Registered professional engineer. Over 31 years experience in structural analysis and evaluation of nuclear structures and equipment using American Society of Mechanical Engineers, American Institute for Steel Construction, and ACI engineering design codes.	X	X			
Joe Yedidia	B.S., Mechanical Engineering, Israel Institute of Technology; M.S., Nuclear Science, Israel Institute of Technology; MBA, University of Pittsburgh. Over 30 years experience in spent fuel systems, reactor utility requirements, liquid metal reactor development, and mechanical and fluid reactor systems.		X			
Jonathan Young	B.A., Mathematics, Lincoln University. Over 30 years experience in systems and safety engineering, safety analysis, probabilistic safety assessment, and system security activities in the aerospace and nuclear industries. Principal instructor and course developer for numerous probabilistic safety assessment courses, both in the United States and abroad.			X		
Greg Yuhas	B.A., Management, St Mary's of California. National Registry of Radiation Protection Technologists. Over 24 years experience in radiation safety, including 17 years with the NRC and 3 years with DOE. Expertise in occupational radiation safety, effluent and environmental monitoring, and decommissioning.	X	X			

Appendix B - Conditions of Acceptance

The conditions of acceptance for the general information evaluation and for the facility specific evaluations are shown below by the section in which they were cited.

Section 3.6 Criticality Safety Program

Conditions of Acceptance – BNI must complete the following with the first PSAR revision following authorization for full facility construction:

1. Revise the CSL for the Pu/metals ratios, which would account for the effects of washing or leaching, as committed to in the response to Question PT-PSAR-090. (See Section 3.6.2, Item 3.)

2. Include in the CSER and the PSAR an analysis showing that backwashing feed from tanks AW-103 and SY-102 will be safely subcritical. Or, if the backwashing feed for AW-103 and SY-102 cannot be shown to be safely subcritical, include in the PSAR a commitment to establish administrative controls prohibiting backwashing feed from tanks AW-103 or SY-102 with nitric acid, as committed to in the response to Question PT-PSAR-321. (See Section 3.6.2, Item 3.)

3. Include in the PSAR and CSER information on fissile material released and accumulated in the offgas system, as committed to in response to Question PT-PSAR-318. (See Section 3.6.2, Item 3.)

4. Include in the PSAR and CSER information on precipitation batch sizes and their Pu content, as committed to in response to Question PT-PSAR-323. (See Section 3.6.2, Item 3.)

5. Document in the PSAR and CSER the basis for diuranate accumulation in the evaporator system not posing a criticality concern, as committed to in response to Question PT-PSAR-085. (See Section 3.6.2, Item 3.)

Section 3.7 Radiation Protection

Conditions of Acceptance – BNI must include the following provisions in the RCP. Except for Item 2 below, these provisions should be provided with the FSAR:

1. Provide a detailed organizational chart that shows the radiation safety organization and its relationship to senior plant personnel and other line managers; also, provide job descriptions defining specific authorities and responsibilities of radiation safety personnel. (See Section 3.7.3, Item 2.)

2. Specify the review and revision cycle of procedures and provide to DOE before the start of the preoperational testing phase. (See Section 3.7.3, Item 3.)

3. Describe the mechanism for ensuring that RWPs are not used past their termination dates. (See Section 3.7.3, Item 3.)

4. Describe the methods for analyzing airborne concentrations; methods for calibrating air sampling and counting equipment; action levels and alarm setpoints; the basis used to determine action levels, investigation levels, and derived air concentrations and minimum detectable activities for the radionuclides; the frequency and methods for analyzing airborne concentrations; counting techniques; specific calculations and levels; action levels and investigation levels; locations of continuous air monitors, if used; and locations of annunciators and alarms. (See Section 3.7.3, Item 6.)

5. Identify the types and quantities of contamination monitoring equipment and the methods and types of instruments used in the radiation surveys. (See Section 3.7.3, Item 7.)

6. Identify the locations of the facility's respiratory equipment. (See Section 3.7.3, Item 11.)

7. Describe the radiation measurement selection criteria for performing radiation and contamination surveys, sampling airborne radioactivity, monitoring area radiation, and performing radioactive analyses. List the types and quantities of instruments that were available, as well as their ranges, counting mode, sensitivity, alarm setpoints, and planned use. Describe the instrument storage, calibration, and maintenance facilities and laboratory facilities used for radiological analyses. (See Section 3.7.3, Item 12.)

Section 3.12 Procedures and Training

Procedures

Conditions of Acceptance – BNI must complete the following changes to Section 12.3 of Volume I of the PSAR with the first PSAR revision following authorization for full facility construction:

1. Revise Section 12.3.1.1 to state that, "The project readiness assessment process determines the procedure set required to support Construction activities. Procedures are developed and issued before the activity governed by the procedure takes place"; in addition, provide a table in Section 12.3.1.1 to indicate which activities are being addressed in management control procedures during design and construction, cold commissioning, and hot commissioning and operations, as committed to in response to Question LAW-PCAR-103. (See Section 3.12.2, Procedures, Item 2.)

2. Revise Section 12.3.2.2 to state, "The procedures covering the following topics are in place as needed for the construction phase of the project. Changes and additions to the procedure set will be identified before cold commissioning and scheduled for completion before the activity taking place: major management control systems, system and facility operations (including control of hazardous processes), major maintenance activities (including safe work practices), hazardous materials control activities, radiological control activities, and emergency response activities (including radiological and

hazardous chemical release)," as committed to in response to Question LAW-PCAR-106. (See Section 3.12.2, Procedures, Item 4.)

3. Revise Section 12.3.1.1 as follows to clarify who can approve procedures: "The procedure process is governed by the project procedure on procedures. It requires that management associated with ES&H and QA review new procedures and concur that they are or are not within the authorization basis. ES&H and QA review changes to existing procedures if they affect the authorization basis or QA requirements. At a minimum, management associated with the relevant safety disciplines concurs with new procedures and changes to existing procedures that affect the authorization basis requirements," as committed to in response to Question LAW-PCAR-104. (See Section 3.12.2, Procedures, Item 6.)

4. Add the following to Sections 12.3.3.1 and 12.3.3.2.1: "The project procedure complies with the WTP QAM and addresses permanent procedure revisions and expedited procedure changes," as committed to in response to Question LAW-PCAR-107. (See Section 3.12.2, Procedures, Item 7.)

5. Add the following to Section 12.3.1.1: "For construction activities, the basic work planning process is based on the concept that for standard construction tasks, step-by-step work instructions are not required. A combination of technical specifications, field procedures, and drawings are used to perform the work. Individuals involved in the work are trained to the requirements. The work is planned using a construction administrative procedure addressing construction work packages. When unique or complex tasks are performed, work planning is addressed in a construction administrative procedure addressing special instruction work packages. This procedure provides for using a work package with additional controls, including, where appropriate, step-by-step instructions," as committed to in response to Question LAW-PCAR-105. (See Section 3.12.2, Procedures, Item 8.)

Training

Conditions of Acceptance - BNI must complete the following changes to Section 12.4 of Volume I of the PSAR with the first PSAR revision following authorization for full facility construction:

1. Define the periodic basis for comparing training materials with the list of tasks selected for training. (See Section 3.12.2, Training, Item 4.)

2. Clearly state in the learning objectives the knowledge, skills, and abilities the trainee must demonstrate; that learning objectives are sequenced based on their relationship to one another; the conditions under which required actions will take place; and the standards of performance the trainee should achieve when completing the training. (See Section 3.12.2, Training, Item 5.)

3. Define review and approval requirements for lesson plans, training guides, and other training materials before they are issued and used. (See Section 3.12.2, Training, Item 6.)

4. Demonstrate that when an actual task cannot be performed and is walked-through, the conditions of task performance, references, tools, and equipment reflect the actual task to the extent possible. (See Section 3.12.2, Training, Item 8.)

5. Define the periodic basis for conducting training program evaluations. (See Section 3.12.2, Training, Item 4.)

Section 3.13 Human Factors

Condition of Acceptance - BNI must complete the following action with the first PSAR revision following authorization for full facility construction:

1. As committed in the response to Question LAW-PSAR-210, implement a Human Factors Implementation Plan following SRD Safety Criterion 4.3-6 and the SRD Appendix B (Section 2.6), which require use of IEEE 1023-1988, Section 6, "Implementation in the Design, Operations, Testing, and Maintenance Process." (See Section 3.13.2, Item 5.)

Section 3.15 Emergency Preparedness

Condition of Acceptance – BNI must complete the following action with the first PSAR revision following authorization for full facility construction:

1. Revise PSAR Section 15.3 to reflect that DOE/RL-94-02, *Hanford Emergency Management Plan*, Section 14.0, "Program Administration," and its requirements will be contained as part of the Emergency Response Plan, as committed to in response to Question LAW-PSAR-012. (See Section 3.15.2, Item 12.)

2. Revise PSAR Section 15 to reflect that, for WTP Emergency Response Plan program administration, BNI will provide WTP input to the Hanford Emergency Readiness Assurance Plan. Develop an internal assessment of the emergency preparedness activities program and implement it before cold commissioning, and develop a vital records program to ensure documents essential to the continued functioning of WTP are available during and after an emergency. This was committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 12.)

3. Revise PSAR Section 15.4.6 to clarify that training and drills will be conducted using DOE G-151.1, *Emergency Management Guide*, Volume V, Section 4.0, "Training and Drills," as a guide. Clarify that the emergency manager will periodically assess the drill and training program, and the results will be used to improve the program. Clarify that all identified deficiencies from drills will be compiled in a database and tracked until adequate corrective actions are implemented. Clarify that management will attend emergency response training to determine where enhancements can be made to ensure that proper training is provided. This was committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 13.)

4. Revise PSAR Section 15.4.6.2 to reflect that exercises will be conducted in accordance with DOE/RL-94-02, *Hanford Emergency Management Plan*, and DOE/RL emergency procedures RLEP 3.10, "Developing Exercise Packages" (DOE-0223, *Emergency Plan Implementing Procedures*), as committed to in response to Question LAW-PSAR-129. (See Section 3.15.2, Item 14.)

Section 3.16 Deactivation and Decommissioning

Conditions of Acceptance – BNI must complete the following changes to Chapter 16 of Volume I of the PSAR with the first PSAR revision following authorization for full facility construction. All of these conditions were previously identified in the Partial Construction Authorization[206] and remain in effect.

1. In Chapter 16 of the PSAR, clarify its commitment to reduce radiation exposure to workers and the public during and following D&D, as committed to in response to Question LAW-PCAR-028. (See Section 3.16.2, Item 1.)

2. Add the following statement to Section 16.3.5: "While the proposed decommissioning method has not been specified, the facility is being designed to limit contamination, facilitate decontamination, and minimize the dose and generation of waste in the event re-use or demolition of the facility is the ultimate decommissioning method," as committed to in response to Question LAW-PSAR-197. (See Section 3.16.2, Item 1.)

3. Change the R1, R2, and R3 contamination classifications listed in Section 16.3.1 to be consistent with current practices, as committed to in response to Question LAW-PCAR-030. (See Section 3.16.2, Item 3.)

Section 3.17 Management, Organization, and Institutional Safety Provisions

Conditions of Acceptance – BNI must complete the following actions. Except for Item 4, the actions should be completed with the first PSAR revision following authorization for full facility construction:

1. Describe organizational responsibilities and staffing interfaces for the CM program in PSAR Volume I, Section 17.4, as committed to in response to Question LAW-PCAR-005. (See Section 3.17.2, Configuration Management, Item 1[c].)

2. Revise the first paragraph in PSAR Volume I, Section 17.4.6, to read, "The USQ process will be established during implementation of the approved FSAR, which will precede start of the hot commissioning portion of the operations phase. The USQ process will allow project management to make changes to the facility, the procedures, and the Authorization Basis documents; …" In addition, establish a "USQ-like" process before

[206] 02-OSR-0289, ORP letter from R. J. Schepens to R. F. Naventi, BNI, "U.S. Department of Energy (DOE) Notice to Proceed with Partial Construction Activities," dated July 9, 2002.

the start of cold commissioning, and describe this process in a PSAR supplement on a schedule providing for adequate review by DOE, as committed to in response to Question LAW-PSAR-161. (See Section 3.17.2, Configuration Management, Item 5[a].)

3. Revise the last sentence of paragraph two in PSAR Volume I, Section 17.4.6, to read, "However, a USQ evaluation is required for a nonconforming or degraded condition if the resolution of the condition is to 'use as is' or 'repair.' A USQ evaluation would also be required for an interim compensatory action that is proposed to deal with the degraded or nonconforming condition as part of the disposition process," as committed to in response to Question LAW-PSAR-160. (See Section 3.17.2, Configuration Management, Item 5[b].)

4. Revise procedure 24590-WTP-GPP-SIND-001-0, *Reporting Occurrences in Accordance with DOE Order 232.1A*, to address hazards and activities for the cold commissioning phase before the start of the preoperational testing phase, as committed to in response to Question LAW-PCAR-037. (See Section 3.17.2, Incident Reporting and Investigation, Item 2.)

Section 3.18 Fire Protection

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Have procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program for performing periodic safety inspections; inspecting and tracking fire barrier penetration seals, doors, dampers, and related devices, as committed to in response to Question LAW-PSAR-218. (See Section 3.18.2, Item 1[b].)

2. Have procedures in place as part of the March 1, 2003, implementation plan for the WTP fire protection program for performing periodic evaluations of the overall WTP fire protection performance and for identifying and tracking fire safety issues, as committed to in response to Question LAW-PSAR-218. (See Section 3.18.2, Item 3[a].)

3. Fully implement the fire prevention program as part of the March 1, 2003, implementation plan for the WTP fire protection program; and revise the Non-Radiological Worker Health and Safety Plan to include the relevant fire protection requirements from Subparts F and J of 29 CFR 1926, "Safety and Health Regulations for Construction," to ensure that an adequate set of fire safety requirements are specified for work at the WTP construction site, as committed to in response to Question LAW-PSAR-215. (See Section 3.18.2, Item 3[c].)

4. As a condition of construction of the LAW, HLW, and PT buildings, BNI should not preclude compliance with the requirements of the 1997 UBC unless relief has been granted by DOE approval of the requested equivalency. (See Section 3.18.2, Item 4.)

5. Revise the analysis in Appendices E.3 and E.8 of the PT PFHA with the first PT PSAR revision following authorization for full facility construction to reflect an ambient temperature of 113°F, as committed to in response to Question PT-PSAR-073. (See Section 3.18.2, Item 5[b]).

6. Include in Chapter 2 of the HLW PFHA, with the first PSAR revision following authorization for full facility construction, the information on the ability to achieve and maintain a safe state after the loss of the melter offgas system components due to credible fire scenarios, as committed to in response to Question HLW-PFHA-037. (See Section 3.18.2, Item 5[c].)

Section 4.1.1 LAW Facility Description

Facility Description

Conditions of Acceptance – BNI must include the following provisions in the PSAR. Except for Item 6 below, these provisions should be provided with the first PSAR revision following authorization for full facility construction:

1. Include the evaluation of the aircraft impact on the LAW building and associated justification, as committed to in response to Question LAW-PSAR-153. (See Section 4.1.1.2, Facility Description, Item 3[f].)

2. Include the commitment to design anchorage using cracked concrete assumptions unless the structure is evaluated and determined to be uncracked, as committed to in response to Question LAW-PSAR-211. (See Section 4.1.1.2, Facility Description, Item 5[c].)

3. Include the methodology to be used for qualifying SDC equipment in the LAW facility, as committed to in response to Question LAW-PSAR-202. (See Section 4.1.1.2, Facility Description, Item 5[g].)

4. Design ITS piping in the LAW building to ASME B31.3, "Process Piping," occasional load criteria, and include this commitment in the PSAR, as committed to in response to Question LAW-PSAR-201. (See Section 4.1.1.2, Facility Description, Item 5[h].)

5. Designate two cranes in the vicinity of the offgas system as SDS SC-III for their seismic safety function to prevent crane components or the bridge from falling on the SDC offgas SSCs. To protect against damage from the third crane (RWH-CRN-00008), provide either a protective cage surrounding the offgas duct in the process area or, if a protective cage cannot be provided, designate the third crane also as SDS SC-III for its seismic safety function to protect the SDC offgas duct from falling crane components or the bridge, as committed to in response to Question LAW-PSAR-200. (See Section 4.1.1.2, Facility Description, Item 5[i].)

6. Provide, as committed to in response to Question LAW-PSAR-207, initial information (from ISM Cycle III) in the first PSAR revision and full information when the FSAR is submitted, for the following (see Section 4.1.1.2, Facility Description, Item 8):

   (a) A detailed analysis of control room habitability for the facility (including the LAW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the LAW facility to place the facility in a safe state, and to evacuate the LAW facility safely

   (b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the LAW design to identify LAW ITS controls and indications that must be provided in the PT control room design to ensure that the LAW can be placed and maintained in a safe state following any DBEs.

7. Include the following commitment, as stated in response to Question LAW-PSAR-207: LAW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the LAW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4. (See Section 4.1.1.2, Facility Description, Item 8.)

Process Description

Conditions of Acceptance – BNI must include the following provisions in the first PSAR revision following authorization for full facility construction:

1. Include the radiological shielding function of the wet process cell walls as an ITS function in the event of a mis-feed of HLW to the LAW facility, as committed to in response to Question LAW-PCAR-098. (See Section 4.1.1.2, Process Description, Item 1.)

Section 4.1.2 LAW Facility Hazard and Accident Analysis

Two conditions of acceptance originally identified in Section 4.1.2, "LAW Facility Hazard and Accident Analysis," in Revision 1 of the SER, were completed:

1. Revise the design calculation report 24590-LAW-DBC-S13T-00005, *Thermal Analysis for Basemat and Pour Cave Walls*, to incorporate the results of the computational fluid dynamics analysis of the pour cave. The analysis must confirm that the concrete temperatures of the melter and pour caves could be maintained within design limits during the postulated glass spill and loss of cooling accident scenario. All structural calculations affected by the computational fluid dynamics analysis must be revised, as appropriate. These should be completed before authorization for full LAW facility construction. (COMPLETE) (See Section 4.1.2.2, Item 8.)

2. Complete hazard and accident analysis of internal flooding, including identification of control strategies required to protect the safety functions of the facility structure, assuming PSAR reference structural design, before the start of full LAW facility construction. (COMPLETE, is superceded by conditions of acceptance [3] and [5] below.) (See Section 4.1.2.2, Item 2.)

Conditions of Acceptance – BNI must complete the following actions, except for Item 5 below, with the first PSAR revision following authorization for full facility construction:

1. Correct the discrepancies related to the CSD records identification system used in SIPD and as referenced in the LAW and HLW PSAR texts and tables, as committed to in responses to Questions LAW-PSAR-069 and -169, and as agreed to in the authorization for construction for walls to grade. (See Section 4.1.2.2, Item 1.)

2. Include the analysis related to the mis-feed hazardous situation, identifying control strategies that include the provision of gamma monitor activated automatic valve closure as SDC SSCs in the PT facility to prevent the mis-feed to the LAW facility and to designate certain LAW process cell shield walls as SDS SSCs to mitigate the event, as committed to in responses to Questions LAW-PCAR-098 and LAW-PSAR-056. (See Section 4.1.2.2, Item 1.)

3. Include interim information on internal flooding events, as committed to in response to Question LAW-PSAR-036. (See Section 4.1.2.2, Item 2.)

4. Include the design features for mitigating the potential for steam explosion in the LAW melter and the results of the evaluation of the potential for water injection via wash water or feed nozzle cooling water, as committed to in response to Question LAW-PSAR-064. (See Section 4.1.2.2, Item 2.)

5. Submit the internal flooding event hazard evaluation (for the preliminary design) to ORP for approval, and receive DOE approval, before start of construction of the nonstructural aspects of the LAW design expected to be credited as SDC or SDS SSCs for the internal flooding event, on a schedule mutually agreed to by ORP and BNI. (See Section 4.1.2.2, Item 2.)

6. Include the results of the offgas system evaluation for ammonium nitrate deposition potential, including what control strategies, if any, will be implemented to address concerns identified through this evaluation, as committed to in response to Question LAW-PSAR-113. (See Section 4.1.2.2, Item 2.)

7. Include that approximately 30 minutes after being on UPS system power, the plant would be evacuated, therefore eliminating the need for exhauster fans to protect the facility workers from NO_x release in the LAW facility, as committed to in response to Question LAW-PSAR-029. (See Section 4.1.2.2, Item 5.)

8. Correct the omission of additional safety functions for the basemat based on the seismic DBE event being SL-2 for the facility and co-located worker, the mis-feed event being

SL-1 for the facility worker, and the liquid spill/overflow from the LAW concentrate receipt vessel being SL-2 for the facility worker, as agreed to in the authorization agreement for walls to grade construction. (See Section 4.1.2.2, Item 8.)

Section 4.1.3 LAW Facility Important-to-Safety SSCs

Condition of Acceptance – BNI must complete the following with the first PSAR revision following authorization for full facility construction:

1. Include a complete list of RRC SSCs, with associated safety functions, as committed to in response to Question LAW-PSAR-066. (See Section 4.1.3.2, Item 1.)

Section 4.2.1 HLW Facility Description

Facility Description

Two conditions of acceptance originally identified in the Revision 0 of this SER, and in effect in the authorization basis, were completed:

1. Perform transient computational fluid dynamics analysis of the DBE 2700-L molten glass spill before authorization for full HLW facility construction. (COMPLETE) (See Section 4.2.1.2, Facility Description, Item 3[f][i].)

2. Provide the seventeen structural calculations that demonstrate structural design adequacy of HLW walls to grade as described in Section 4.2.1.2, Facility Description, Item 3(b) of this SER. (COMPLETE)

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Include an evaluation of the aircraft impact on the HLW building and associated justification, as committed to in response to Question LAW-PSAR-153, with the first PSAR revision following authorization for full facility construction. (See Section 4.2.1.2, Facility Description, Item 3[f][iii].)

2. Include the commitment to design anchorage using cracked concrete properties, as committed to in response to Question HLW-PSAR-256, with the first PSAR revision following authorization for full facility construction. (See Section 4.2.1.2, Facility Description, Item 4.)

3. Include information on the analysis of the potential effects on ventilation and air-cleaning SSCs of common-cause external events, including volcanic ashfall, in the first PSAR revision following completion of the analysis and in the FSAR, as committed to in response to Question PT-PSAR-257. (See Section 4.2.1.2, Facility Description, Item 7.)

4. Provide, as committed to in response to Question HLW-PSAR-224, initial information (from ISM Cycle III) in the first PSAR revision following authorization for full facility construction and full information when the FSAR is submitted, for the following (see Section 4.2.1.2, Facility Description, Item 8):

   (a) A detailed analysis of control room habitability for the facility (including the HLW building) to demonstrate that there is adequate time to evaluate accident conditions, to perform mitigating actions required at the HLW facility to place the facility in a safe state, and to evacuate the HLW facility safely

   (b) A systematic evaluation of ITS SSCs and non-ITS equipment that may impact ITS SSCs and an analysis of the HLW design to identify HLW ITS controls and indications that must be provided in the PT control room design to ensure that the HLW can be placed and maintained in a safe state following any DBEs.

5. Include the following commitment in the first PSAR revision, following authorization for full facility construction, as stated in response to Question HLW-PSAR-224: HLW SDC and SDS controls and indications provided in the PT control room that are required to place/maintain the HLW facility in a safe state following any DBEs will be independent of the integrated control network controls and indications and will be designed according to the standards in SRD Safety Criterion 4.3-4. (See Section 4.2.1.2, Facility Description, Item 8.)

Process Description

Conditions of Acceptance - One condition of acceptance originally identified in the Revision 0 of this SER and in effect in the authorization basis, was completed:

1. Revise the design drawings that were used to support the hazard and accidental analysis of the embedded C5 ventilation ductwork to reflect the configuration used in the accident analysis with the first PSAR revision following authorization for full facility construction. (COMPLETE) (See Section 4.2.1.2, Process Description, Item 5)

Conditions of Acceptance – BNI must complete the following in the first PSAR revision following authorization for full facility construction:

1. Include information on monitoring vessel vent and overflow lines to ensure their functionality, as committed to in response to Question HLW-PSAR-010. (See Section 4.2.1.2, Process Description, Item 4.)

2. Revise HLW PSAR Tables 3-3, 3-4, and 3-5 to eliminate shortcomings in the chemical compatibility assessments identified by the reviewers, as committed to in response to Question HLW-PSAR-017. (See Section 4.2.1.2, Process Description, Item 9.)

Section 4.2.2 HLW Facility Hazard and Accident Analysis

Three conditions of acceptance originally identified in the Revision 1 of this SER were completed and one remains open:[207]

1. Correct the discrepancies between the CSD records in Appendix A and the HLW PCAR and PSAR text and tables, as committed to in responses to Questions LAW-PSAR-069 and -169 and as agreed to in the authorization for construction of HLW walls to grade. (See Section 4.2.2.2, Item 1.) (OPEN – must be closed as part of the first PSAR revision following authorization for full facility construction.)

2. Provide the DBE analysis of the 2700-L molten glass spill accident. (COMPLETE)

3. Complete hazard and accident analysis of internal flooding, including identification of control strategies required to protect the safety functions of the facility structure, assuming PCAR and PSAR reference structural design, before the start of full HLW facility construction. (COMPLETE; superceded by conditions 4 and 5 below)

Conditions of Acceptance – BNI must complete the following with the first PSAR revision following the authorization for full facility construction (except as noted in Items 5 and 13 below):

1. Analyze the potential for ammonia in the HLW feed to be released from the liquid phase into the gaseous phase, reaching a flammable concentration and igniting, as committed to in response to Question HLW-PSAR-240. (See Section 4.2.2.2, Item 1.)

2. Include the results of the offgas system evaluation for ammonium nitrate deposition potential, including the control strategies, if any, that will be implemented to address concerns identified through this evaluation, as committed to in response to Question HLW-PSAR-024. (See Section 4.2.2.2, Item 1.)

3. Include information on overflow events involving submerged bed scrubber condensate vessels, including control strategies, as committed to in response to Question HLW-PSAR-127. (See Section 4.2.2.2, Item 1.)

4. Include interim information on internal flooding events, as committed to in response to Question HLW-PSAR-003. (See Section 4.2.2.2, Item 2[a].)

5. Submit the internal flooding event hazard evaluation (for the preliminary design) to ORP for approval, and receive DOE approval, before start of construction of the nonstructural aspects of the HLW design expected to be credited as SDC or SDS SSCs for the internal

[207] The HLW walls to grade SER condition of acceptance (condition [2]) – submit an evaluation of the combined effects of seismically induced radiological releases from the PT, LAW, and HLW buildings on the workers, co-located workers, and the public through a seismic probabilistic risk analysis study – is addressed in Section 4.6 of this SER.

flooding event, on a schedule mutually agreed to by ORP and BNI. (See Section 4.2.2.2, Item 2[a].)

6. Revise Section 4.4.4 to explicitly address all incoming feeds as sources to the concentrate receipt tank that may result in vessel overflow events, as committed to in response to Question HLW-PSAR-188. (See Section 4.2.2.2, Item 2[a].)

7. Perform a sensitivity study to compare respirable releases from a crack to an orifice and revise the calculations and PSAR, as necessary, as committed to in response to Question HLW-PSAR-128. (See Section 4.2.2.2, Item 3.)

8. Re-analyze the hydrogen generation deflagration DBE and the PSAR based on re-evaluation of the hydrogen correlation used in the event analysis, as committed to in response to Question HLW-PSAR-235. (See Section 4.2.2.2, Item 3[a].)

9. Revise the PSAR to show that the HLW melter shell will be qualified to SC-II, as committed to in response to Question HLW-PSAR-150. (See Section 4.2.2.2, Item 3[b].)

10. Remove the 6600-L molten glass spill as a DBE from PSAR Section 3.4.1.4, as committed to in response to Question HLW-PSAR-253. (See Section 4.2.2.2, Item 3[b].)

11. Include a description of the 2700-L molten glass spill event and associated control strategies, as committed to in responses to Questions HLW-PCAR-012 and HLW-PSAR-191. (See Section 4.2.2.2, Item 3[b].)

12. Revise 24590-HLW-Z0C-W14T-00013, *Revised Severity Level Calculations for the HLW Facility*, and 24590-HLW-Z0C-H01T-00001, *Design Basis Event – HLW Process Vessel Hydrogen Deflagrations*, to more conservatively account for the radiolytic affects (i.e., the concentrations of the nitrate/nitrite ions by using Equation 2-3 from RPT-W375-SA00002, *Topical Report on the Management of Risks Posed by Explosive Hazards Present at the RPP-WTP*, rather than Equation 2-2) and the thermolytic affects (i.e., by establishing design air purge flow rates through vessel head spaces using an activation energy, e_a, of 100 kJ/mole [vs. 91 kJ/mole] and assuming the vessels are at 220°F). This was committed to in response to Questions HLW-PSAR-235 and PT-PSAR-336. (See Section 4.2.2.2, Item 4[b].)

13. Re-evaluate transportation events as part of the control room habitability evaluations and include initial results of this HLW evaluation in the first PSAR revision following authorization for full facility construction and include final results in the FSAR. This was committed to in response to Question PT-PSAR-204. (See Section 4.2.2.2, Item 6[c][vi]).

Section 4.2.3 HLW Facility Important-to-Safety SSCs

Conditions of Acceptance – BNI committed to complete the following in the first revision of the HLW PSAR following the authorization for full HLW facility construction:

1. Include a complete list of RRC SSCs, with associated safety functions, as committed to in responses to Questions HLW-PSAR-039, -170, -213, -250, -251, and -252. (See Section 4.2.3.2, Item 1.)

2. Update the HLW PSAR to clarify the inclusion of ITS purge air into the spare process lines (concentrate receipt vessel stub out lines), as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

3. Delete the ABCN proposed addition to HLW PSAR Section 3.4.1.1.2.6, which read, "Subsequent failure of the secondary pipe, should the primary pipe leak, is not eminent (sic) within a reasonable time frame for detection of the primary pipe leak via the cell leak detection system," as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

4. Perform a confirmatory calculation or other documentation that shows that the design of the melter pour spout drip tray accomplishes the bulk confinement of inadvertent melter pours based on melter experience with similar designs and document the results in the HLW PSAR, as committed to in discussions with DOE. (See Section 4.2.3.2, Item 1.)

5. Revise the appropriate section of Table 4-1 to identify the SDC bulge and SDC lines (primary and secondary) to be consistent with the ABCN text descriptions, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

6. Revise the PSAR to state that the secondary piping of the concentrate receipt vessel coaxial containment piping will be routed to the wet process cell, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

7. Add the slope requirement for the coaxial containment/spare process piping as an explicit design feature in HLW PSAR Sections 4.3.7.6 and 5.6.2, as committed to in response to Question HLW-PSAR-260. (See Section 4.2.3.2, Item 1.)

8. Revise HLW PSAR Section 5.5 to include draft limiting conditions of operation and surveillance requirements for the melter pour spout drip tray, as committed to in discussions with DOE. (See Section 4.2.3.2, Item 1.)

9. Correct the information in the PSAR on the safety functions of the high-high level interlocks, quality of instrument air, design of the hydrogen mitigation system to meet the single-failure criteria of the SRD, Appendix A, the design of the C5 ventilation system for wind effects, and the seismic qualification (SC-I) of the smoke/fire dampers. This was committed to in responses to Questions HLW-PSAR-051, -098, -120, -184, -189, -190, -228, and -229. (See Section 4.2.3.2, Item 2.)

10. Correct the information in the PSAR on the functional requirements for the canister handling crane and grapple, immobilized HLW cask, impact absorbers, and HEPA filter preheaters, as committed to in responses to Questions HLW-PSAR-023, -058, -059, and -099. (See Section 4.2.3.2, Item 4.)

Section 4.3.1 PT Facility Description

Facility Description – The reviewers concluded that the facility description was conditionally acceptable. In addition, six conditions of acceptance identified in Revision 2 of this SER were completed.

Conditions of Acceptance – BNI must complete the following actions and obtain DOE acceptance of the information provided as conditions of acceptance before DOE authorization of PT subsurface pits, tunnels, and basemat structural concrete placement:

1. Develop a structural design evaluation summary table, as committed to in response to Question PT-PSAR-227. (See Section 4.3.1.2, Item 3[b].) (COMPLETE)

2. From the preliminary SSI analysis results, for each wall and horizontal seismic motion, tabulate (a) the in-plane shear force in the direction of the length of the wall, (b) the maximum in-plane shear stress in the direction of the length of the wall, and (c) maximum out-of-plane bending moments, one about the horizontal axis and one about the vertical axis. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

3. Compare the out-of-plane bending moments in the subsurface walls from the preliminary SSI analysis for the horizontal seismic motions with those from the GTSTRUDL analysis of the PT building. The applied dynamic soil pressure is based on ASCE 4-98, *Seismic Analysis of Safety-Related Nuclear Structures and Commentary*. These were committed to in responses to Questions PT-PSAR-227. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

4. Modify the design moments and shear forces in calculation report 24590-PTF-DGC-S13T-00002, *Design of Pits, Foundations and Below Grade Walls for PT Building*, using a method similar to that used in the HLW facility design. Include this effect on demand-to-capacity ratios in the structural design evaluation summary. These commitments were provided in the responses to Questions PT-PSAR-227 and -231. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

5. Include both through-thickness thermal loads and thermal growth loads in design calculations and provide justification for not considering all load combinations, as committed to in responses to Questions PT-PSAR-225, -226, and -227. (See Section 4.3.1.2, Item 3[g].) (COMPLETE)

6. Provide a code requirement interpretation for shear wall design limits that would provide a basis for concluding that the shear forces were acceptable using ACI 349-01, as committed to in response to Question PT-PSAR-227. (See Section 4.3.1.2, Item 4.) (COMPLETE)

7. Perform a revised seismic SSI analysis based on the revised building layout in which lateral dynamic soil pressure will be calculated directly for a few critical below-grade walls using soil pressure elements in the SASSI model before authorization for full PT facility construction. If soil pressure is not obtained directly from the revised SSI

analyses, the SASSI-generated moment results will be used to estimate the lateral dynamic soil pressure. This was committed to in responses to Questions PT-PSAR-224 and -227. (See Section 4.3.1.2, Item 3[d].) (COMPLETE)

BNI must complete the following by the date or milestone indicated:

1. Perform an evaluation of PT internal flooding as part of the common-cause/common-mode failure analysis during ISM Cycle III; identify control strategies for internal flooding events, as necessary, to prevent unacceptable impacts to the safety function of the structure located above the basemat. Before floors are constructed above the basemat, demonstrate, in the flooding assessment, the vulnerability to flooding from internal sources. Where vulnerabilities are detected, provide appropriate mitigation. Provide the results from this analysis to ORP for approval and document them in the first PSAR revision following completion of the hazard analysis. This was committed to in response to Question PT-PSAR-256. (See Section 4.3.1.2, Item 3[f][ii].)

2. Update the SDC UPS description in the PSAR to provide one Plant Protection System division and one respective UPS power division for each redundant SDC division in the PT facility by the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-205. (See Section 4.3.1.2, Item 6.)

Process Description – The reviewers concluded that the process description was conditionally acceptable.

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Assess tank waste characterization data and internal WTP process streams including solids particle size distribution and waste solids hardness. Also re-assess requirements selected for erosion/corrosion based on this assessment. Document the results of this assessment in the first revision of the PSAR following authorization for full facility construction. (See Section 4.3.1.2, Item 3.)

2. Perform additional laboratory tests to establish a safe upper limit for nitric acid concentration with new and degraded resin. Complete the laboratory tests and include the evaluation of the results in the PSAR at the time the testing is complete and the control system and ion-exchange column design is finalized, as committed to in response to Question PT-PSAR-025. (See Section 4.3.1.2, Item 9.)

Section 4.3.2 PT Facility Hazard and Accident Analysis

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Perform a hazard analysis for water hammer and consider water hammer loads in the design of piping supports in the ISM Cycle III hazard topography process and document the results in the following annual PSAR update, as committed to in response to Question PT-PSAR-276. (See Section 4.3.2.2, Item 1.)

2. Analyze the release rate and ammonia concentration and document the result in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-199. (See Section 4.3.2.2, Item 1.)

3. Develop and include a basis for the frequency and locations of periodic flushing (if needed) of vent lines to prevent ammonium nitrate buildup and determine the need for inspection ports in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-290. (See Section 4.3.2.2, Item 1.)

4. Revise discussions in the PSAR pertaining to sampling to eliminate inconsistencies and incorporate administrative controls described in the LAW and HLW sections of the PSAR for sampling required to protect the LAW and HLW facilities in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-333. (See Section 4.3.2.2, Item 1.)

5. Verify that design features for diluting sodium permanganate are inherent using Revision 0 design media, and if necessary, include an ITS permanganate concentration monitor in the design or a TSR to preserve minimum heel volumes in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-025. (See Section 4.3.2.2, Item 2.)

6. Revise severity level calculations and DBE calculations to account for ^{241}Am concentrations at Contract maximum in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-029. (See Section 4.3.2.2, Item 3.)

7. Incorporate changes to DBE calculations, seismic probabilistic risk analysis, operation risk assessment, and the PSAR resulting from reconfiguration of shear walls to address seismic forces and resizing of HLP system vessels in the first PSAR revision following authorization for full facility construction, as committed to in response to Question PT-PSAR-256. (See Section 4.3.2.2, Item 3.)

8. Revise hydrogen generation rates and severity level analysis in the first revision of the PSAR following authorization for full facility construction to do the following:

   (a) Revise the calculation in 24590-PTF-Z0C-W14T-00002, *Revised Severity Level Calculation for the Pretreatment Facility*, to more conservatively account for the concentration of the nitrate/nitrite ions by using Equation 2-3 from RPT-W375-SA00002, *Topical Report on the Management of Risks Posed by Explosive Hazards Present at the RPP-WTP*. This was committed to in response to Question PT-PSAR-023. (See Section 4.3.2.2, Item 3[a].)

(b) Perform all hydrogen generation rate calculations for tanks that could self-boil within 300 hours using a maximum temperature of 220°F and increased activation energy (100 kJ/mole), as committed to in response to Question PT-PSAR-336. (See Section 4.3.2.2, Item 3[a].)

(c) Designate hydrogen deflagration events to be SL-1 for all receptors, as committed to in response to Questions PT-PSAR-024 and -028. (See Section 4.3.2.2, Item 3[a].)

(d) Evaluate the potential for piping systems and ancillary equipment to accumulate hydrogen as well as potential control strategies, as committed to in response to Question PT-PSAR-289. (See Section 4.3.2.2, Item 3[a].)

(e) Finalize calculations to verify that the instrument air supply rate and noncondensed steam conditions are sufficient to keep the evaporators below 25% of the lower flammability limit in the offgas systems, as committed to in response to Question PT-PSAR-293. (See Section 4.3.2.2, Item 3[a].)

9. Develop administrative controls during ISM Cycle III to prevent hydrogen buildup in vessels containing low liquid levels when pulse jet mixers are automatically stopped and document the results in the FSAR, as committed to in response to Question PT-PSAR-294. (See Section 4.3.2.2, Item 3[a].)

10. Correct calculation errors documented in Questions PT-PSAR-023, -042, -199, -258, and -259, as committed to in response to these questions in the first revision of the PSAR following authorization for full facility construction. (See Section 4.3.2.2, Item 3[a].)

11. Reconsider the need for the emergency elution system in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-025. (See Section 4.3.2.2, Item 3[b].)

12. Delete references to target frequencies in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Questions PT-PSAR-051, -052, -055, -125, -127, and -211. (See Section 4.3.2.2, Item 4.)

13. Evaluate the flooding hazard for ITS equipments (both electrical and mechanical) as part of the hazard topography evaluation scheduled during ISM Cycle III and document results in the PSAR annual updates, as committed to in response to Question PT-PSAR-256. (See Section 4.3.2.2, Item 5.)

14. Address failure of the temperature control system or a steam supply valve in the ultrafiltration feed tank in the DBE boiling calculation in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-198. (See Section 4.3.2.2, Item 6[a].)

15. Develop a separate tank bump DBE analysis and document the results in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-098. (See Section 4.3.2.2, Item 6[a].)

16. Include the revised DBE analysis for leaks in the transfer line between the tank farms and the PT facility in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-055. (See Section 4.3.2.2, Item 6[a].)

17. Document that shield doors and hatches will be required to fail in their last position on a seismic event. This information and necessary revisions to seismic qualification of these interlocks shall be incorporated in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-003. (See Section 4.3.2.2, Item 6[b][viii].)

18. Revise Table 3A-27 of the PSAR to reflect that the volume of the overflow collection vessels and the hot cell pit are sufficient to contain the overflow for the time required to implement emergency procedures to stop all transfers. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-003. (See Section 4.3.2.2, Item 6[b][viii].)

19. Revise the PSAR to reflect that the cask and sealed metal container placed in the cask would provide two physical barriers credited to mitigate the consequences of a load drop in the truck bay. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-074. (See Section 4.3.2.2, Item 8.)

20. Add a description of redundant chilled water booster pumps and associated ITS instrumentation and controls to the cooling water supply header for the cesium and technetium in line heat exchangers to meet the required design criterion to have cooling water pressure greater than vessel pressure. This must be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-042. (See Section 4.3.2.2, Item 8.)

21. Correct SSC descriptions and inconsistencies in the PSAR, referenced drawings, and DBE calculations in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Questions PT-PSAR-270, -271, and -275. (See Section 4.3.2.2, Item 9.)

PT Important-to-Safety SSCs

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. Identify RRC SSCs and correct the list of identified RRC SSCs in the first PSAR revision following authorization for full facility construction, as committed to in response to Questions PT-PSAR-239 through -242. (See Section 4.3.3.2, Item 1.)

2. Include a complete list of RRC SSCs with associated safety function in the first PSAR revision following authorization for full facility construction, as committed to in response to Questions PT-PSAR-239 through -242. (See Section 4.3.3.2, Item 2.)

3. Confirm in a DBE calculation that water-saturated air caused by a break in the evaporator steam line will be mixed with enough dry air from other C5 cells before it reaches the primary C5 ventilation system filters to preclude exceeding moisture limitations or propose alternate controls. This will be done in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-287. (See Section 4.3.3.2, Item 4.)

4. Evaluate use and proper sizing of the bulge vent line to supplement drain capacity as part of the PSAR control strategy to provide bulge drains before bulge procurements are complete, as committed to in response to Question PT-PSAR-297. (See Section 4.3.3.2, Item 4.)

5. Update the PSAR to be consistent with DBE calculation report 24590-PTF-Z0C-10-00005, *Design Basis Event – Pretreatment Loss of Contamination Control*, to specify redundant radiation monitors and interlocks for minimizing contamination in the evaporator/condensate systems in the first revision of the PSAR following authorization for full facility construction, as committed to in response to Question PT-PSAR-008. (See Section 4.3.3.2, Item 5.)

6. Analyze the potential effects on ventilation and air-cleaning SSCs of common-cause external events, such as volcanic ashfall, and document the results in the first PSAR revision following completion of the analysis, as committed to in response to Question PT-PSAR-257. (See Section 4.3.3.2, Item 5.)

Section 4.4.1 BOF Facility Description

Facility Description

Conditions of Acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. As discussed in Section 4.4.1.2, Facility Description, Item 6:

   (a) Provide the electrical design basis for the ITS electrical ductbank, as committed to in response to Question BOF-PSAR-007.

   (b) Clarify the design basis for ITS monitoring and control circuits in the ITS electrical ductbank, as committed to in response to Question BOF-PSAR-006.

(c) Provide a description of the system for starting EDGs, as committed to in response to Question BOF-PSAR-008.

Process Description

Conditions of Acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. Describe application of the single failure criterion to the nitric acid monitor as committed to in response to Question BOF-PSAR-005. (See Section 4.4.1.2, Process Description, Item 6.)

2. Delete the ITS sodium permanganate monitor as committed to in response to Question BOF-PSAR-005. (See Section 4.4.1.2, Process Description, Item 7.)

Section 4.4.2 BOF Hazard and Accident Analysis

Conditions of acceptance – BNI must complete the following actions in the first PSAR revision following authorization for full facility construction:

1. Correct CSD and safety case requirement identification numbers in the PSAR and referenced documents, as committed to in response to Question BOF-PSAR-010. (See Section 4.4.2.2, Item 1.)

2. Analyze the potential effects of a design basis ashfall event and provide controls, as committed to in response to Question PT-PSAR-204. (See Section 4.4.2.2, Item 1.)

Section 4.4.3 BOF Important-to-Safety SSCs

Conditions of Acceptance – BNI must complete the following action in the first PSAR revision following authorization for full facility construction:

1. Correct RRC SSC identification errors between Volume II, IV, and V of the PSAR, as committed to in response to Question BOF-PSAR-016. (See Section 4.4.3.2, Item 1.)

Section 4.6 Safety Basis/Conformance with Facility Risk Goals

Conditions of Acceptance – BNI must complete the following actions by the date or milestone indicated:

1. Complete the seismic probabilistic risk analysis, demonstrating compliance to the risk goals of SRD Safety Criteria 1.0-3, 1.0-4, and 1.0-5 (excluding the Analytical Laboratory). This must be completed before authorization for full facility construction. (COMPLETE) (See Section 4.6.2, Item 1.)

2. Include in the first PSAR revision following authorization for full facility construction, a table of risk dominant events for the LAW facility, as committed to in response to Question LAW-PSAR-168. (COMPLETE) (See Section 4.6.2, Item 2.)

3. Update the operations risk assessment to document a fully integrated facility-wide analysis that would include LAW, HLW, and PT before full facility construction authorization, as committed to in response to Question HLW-PSAR-206. (COMPLETE) (See Section 4.6.2, Item 2)

4. Document the results from the integrated seismic probabilistic risk analysis and operations risk assessment in the PSAR in the first revision of the PSAR following authorization for full facility construction. (See Section 4.6.2, Items 1 and 2.)

Section 6.3.2 SRD and ISMP Acceptability and Compliance

Conditions of Acceptance – BNI must complete the following by the date or milestone indicated:

1. BNI will implement the corrective actions specified in Attachment 2, "Assessment of the Effect of Design Process Implementation Issues on Construction Authorization Readiness," to the BNI letter dated October 30, 2002.[208] These corrective actions must be completed by the dates provided in the letter. (See Section 6.3.2, Item 1.)

2. BNI will perform a thorough assessment of the effectiveness of the engineering work performance improvement initiatives for all disciplines performing engineering design work, submit the assessment results, and identify any additional corrective actions deemed necessary before the first revision of the PSAR following authorization for full facility construction. (Section 6.3.2, Item 1.)

3. Update PSAR Volume I, *General Information*; Table 2-6, "Categorization of Piping"; Section 2.4.9, "Piping Design"; and Section 2.4.10, "Pipe Support Design," to be consistent with the SRD implementing standards for piping and pipe support design in the first revision of the PSAR after full facility construction authorization, as committed to in response to Question PT-PSAR-339. (See Section 6.3.2, Item 3[b].)

4. As a condition on the construction, BNI must retain the option to design and install automatic fire suppression for the affected areas and is not authorized to construct SSCs that implement control strategies that are inconsistent with meeting the current SRD requirements. This condition of acceptance excludes nine rooms in the HLW building, (per revised SRD Safety Criterion 4.5-4 and 24590-WTP-ABAR-ESN-03-008, *Modification of SRD Safety Criterion 4.5-4 to Allow Omission of Automatic Fire Suppression Systems from High Radiation Areas.* (See Section 6.3.2, Item 3[h].)

[208] CCN: 042775, BNI letter from A. R. Veirup to R. J. Schepens, ORP, "Hanford Tank Waste Treatment and Immobilization Plant – Construction Authorization Readiness in Consideration of Recent Assessments and Inspections of Engineering Activities," dated October 30, 2002.