RL/REG-2000-07
Revision 0

REGULATORY UNIT POSITION ON ACCEPTABILITY OF THE TWRS-PRIVATIZATION DOSE STANDARDS FOR UNLIKELY AND EXTREMELY UNLIKELY EVENTS

February 23, 2000

Office of Safety Regulation of the TWRS-P Contractor

U.S. Department of Energy
Richland Operations Office
P. O. Box 550, A4-70
Richland, Washington 99352

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PREFACE

The U.S. Department of Energy's (DOE) Richland Operations Office (RL) issued a request for proposal in February 1996 for privatized processing of waste as part of the Hanford Tank Waste Remediation System (TWRS) program which in 1999 came under the cognizance of the Office of River Protection (ORP). Offerors were requested to submit proposals for the initial processing of the tank waste at the Hanford Site. Some of this radioactive waste has been stored in large underground storage tanks at the Site since 1944. Currently, approximately 54 million gallons of waste containing approximately 250,000 metric tons of processed chemicals and 215 million curies of radionuclides are being stored in 177 tanks. These caustic wastes are in the form of liquids, slurries, saltcakes, and sludges. The wastes stored in the tanks are defined as high-level radioactive waste (10 CFR Part 50, Appendix F) and hazardous waste (Resource Conservation and Recovery Act).

Under the privatization concept, DOE intends to purchase waste processing services from a Contractor-owned, Contractor-operated facility through a fixed-price contract. DOE will provide the waste feedstock for processing but maintain ownership of the waste. The Contractor must: (a) provide private financing; (b) design the equipment and facility; (c) apply for and receive required permits and licenses; (d) construct the facility and commission its operation; (e) operate the facility to process tank waste according to DOE specifications; and (f) deactivate the facility.

The TWRS Privatization (TWRS-P) project is divided into two phases, Phase I and Phase II. Phase I is a proof-of-concept/commercial demonstration-scale effort. The objectives of Phase I are to (a) demonstrate the technical and business viability of using privatized Contractors to process Hanford tank waste; (b) define and maintain adequate levels of radiological, nuclear, process, and occupational safety; (c) maintain environmental protection and compliance; and (d) substantially reduce life-cycle costs and time required to process the tank waste. The Phase I effort consists of three parts: Part A, Part B-1, and Part B-2.

Part A, which concluded in August 1998, was a 20-month period to establish technical, operational, regulatory, and financial elements necessary for privatized waste processing services at fixed-unit prices. This included identification by the TWRS-P Contractors and approval by DOE of appropriate safety standards, formulation by the Contractors and approval by DOE of integrated safety management plans, and preparation by the Contractors and evaluation by DOE of initial safety assessments. Of the 20-month period, 16 months was for the Contractors to develop the Part A deliverables and four months was for DOE to evaluate the deliverables and determine whether to authorize Contractors to perform Part B. Part A culminated in DOE's authorization on August 24, 1998, of BNFL Inc. to perform Part B-1.

Part B-1 is a 24-month period to (a) further the waste processing system design introduced in Part A, (b) revise the technical, operational, regulatory, and financial elements established in Part A, (c) provide firm fixed-unit prices for the waste processing services, and (d) achieve financial closure.

Part B-2 is a 16-year period to complete design, construction, and permitting of the privatized facilities; provide waste processing services for representative tank wastes at firm fixed-unit prices; and deactivate the facilities. During Part B-2, approximately 10% by volume (25% by activity) of the total Hanford tank wastes will be processed.

Phase II will be a full-scale production effort. The objectives of Phase II are to implement the lessons learned from Phase I and to process all remaining tank waste into forms suitable for final disposal.

An essential element of the TWRS-P Project is DOE's approach to safety regulation. DOE has specifically defined a regulatory approach and chartered a dedicated Office of Safety Regulation of the TWRS-P Contractor (Regulatory Unit). The DOE aim in proceeding with the safety regulation of the TWRS-P Contractor is to establish a regulatory environment that will permit privatization to occur on a timely, predictable, and stable basis. In addition, attention to safety must be consistent with that which would accrue from regulation by external agencies. DOE is patterning its radiological and nuclear safety regulation of the TWRS-P Contractor to be consistent with that of the U.S. Nuclear Regulatory Commission (NRC). For industrial hygiene and safety (IH&S), regulation is consistent with that of the Occupational Safety and Health Administration (OSHA).

The RL Manager has responsibility and authority for safety regulation and has assigned this authority to the RL Director of the TWRS-P Regulatory Unit (the Regulatory Official). This regulatory authority is exclusive to the regulation of the TWRS-P Contractor. The Regulatory Official is the formal point of execution for safety regulation of the TWRS-P Contractor.

The DOE requires the Contractor to integrate safety into work planning and execution. This Integrated Safety Management (ISM) process emphasizes that it is the Contractor's direct responsibility for ensuring that safety is an integral part of mission accomplishment. The privatized Contractor has primary responsibility for safety. The DOE, through its program, is responsible for verifying that the Contractor establishes and complies with approved safety limits.

The relationship between DOE and the privatized Contractor performing work under a fixed-price contract is different than the relationship under traditional Management and Operations (M&O) contracts. For fixed-price contracting to be successful, this different safety relationship with the Contractor is accompanied by modified relationships among DOE's internal organizations. For example, the arrangement by which the RL Manager applies regulation to the TWRS-P Contractor should be a surrogate for an external regulator (such as the NRC or OSHA) with strong emphasis on independence, reliability, and openness.

Regulation by the RU in no way replaces any legally established external regulatory authority to regulate in accordance with their duly promulgated regulations nor relieves the Contractor from any obligations to comply with such regulations or to be subject to the enforcement practices contained therein.

All documents issued by the Office of Safety Regulation of TWRS-P Contractor are available to the public through the DOE/RL Public Reading Room at the Consolidated Information Center, Room 1012, Richland, Washington. Copies may be purchased for a duplication fee.

RECORD OF REVISION

Document Title: RU Position on Acceptability of the TWRS-P Dose Standards for Unlikely and Extremely Unlikely Events

Document Number: RL/REG-2000-07

Revision Date	**Revision Number**	**Reason for Revision**
2-23-00	0	New issue.

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REGULATORY UNIT POSITION ON ACCEPTABILITY OF THE TWRS-PRIVATIZATION DOSE STANDARDS FOR UNLIKELY AND EXTREMELY UNLIKELY EVENTS

1.0 PURPOSE

This position paper presents the results of a review of the acceptability of the radiation dose standards for postulated accidents at the proposed Tank Waste Remediation System Privatization (TWRS-P) facility. These standards are part of a process used to ensure that the facility is provided with adequate structures, systems, and components (SSCs) that are important to safety. This position paper addresses the appropriateness of certain dose standards, specifically the Contractor-derived dose standard of 25 rem for workers and co-located workers in the Unlikely Event and Extremely Unlikely Event categories and the dose standards of 5 rem and 25 rem for members of the public in those categories. This paper reviews the basis for these dose standards and provides the rationale for concluding that the dose standards are appropriate as part of a comprehensive program that includes mandatory safety principles, including defense-in-depth principles and a regulated integrated safety management process, to ensure adequate safety for workers, co-located workers, and the public.

2.0 BACKGROUND

The U.S. Department of Energy (DOE) regulatory process described in the Contract[1] for the proposed vitrification facility requires the Contractor (BNFL Inc.) to establish standards to limit the radiation dose to facility workers (workers) and other Hanford Site workers (co-located workers) from the radiological consequences of normal operations and credible accident events. As part of these standards, the Contractor must derive dose standards for postulated accidents with frequencies between 10^{-2} to 10^{-6} per year. All other dose standards for workers, co-located workers, and members of the public are specified by Contract. Also, the Contractor is required to have an overall approach to safety that integrates the following:

- Radiation dose standards for normal operations and accident events
- As low as reasonably achievable (ALARA) design objectives
- Risk goals for operating the facility
- Limits on effluent releases
- Mandatory defense-in-depth standards.

The requirements for all of these standards are established in DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, Section 2.0, "Radiological and Nuclear Safety Standards," Section 3.0, "Radiological and Nuclear Safety Objectives," and Section 4.0, "General Radiological and

[1] Contract No. DE-AC06-96RL13308, between DOE and BNFL Inc., dated August 24, 1998.

Nuclear Safety Principles." Section 2.1 of DOE/RL-96-0006 includes Table 1, "Dose Standards Above Normal Background."

The Contractor has addressed radiological and nuclear safety standards in the regulatory submittal, TWRS-Privatization Radiological and Nuclear Exposure Standards for Facility and Co-located Workers (RESW), and has addressed the radiological and nuclear safety objectives in the regulatory submittal, Safety Requirements Document (SRD). The RESW is included as Appendix D to the SRD. The standards proposed by BNFL in its RESW and SRD require compliance with all applicable laws and regulations and provide for adequate safety. The SRD was approved by the RU in RL/REG-98-01, *DOE Regulatory Unit Evaluation Report of the BNFL Inc. Safety Requirements Document*, and is maintained as part of the authorization basis.

The RESW establishes both radiation dose and ALARA design standards for workers, co-located workers, and the public. It addresses normal operations as well as credible accident events. The RESW includes four BNFL-derived standards for the worker and co-located worker at the postulated accident probability ranges of Unlikely Events and Extremely Unlikely Events. To assist the Contractor with its derivation, the Contract provides reference to examples of such derived standards and implementation approaches in EH-12-94-01, *Methods for the Assessment of Worker Safety Under Radiological Accident Conditions at Department of Energy Nuclear Facilities*.

The dose standards apply to mitigated accidents, i.e., conformance to the standards is demonstrated by considering the conservative estimate of the frequency and the dose consequences of a postulated event sequence. The dose standards for accidents as presented in the RESW and SRD are summarized below.

Categories of Individuals	Unlikely Events (Frequency of 10^{-4} to 10^{-2})	Extremely Unlikely Events (Frequency of 10^{-6} to 10^{-4})
Workers	25 rem/event	25 rem/event
Co-located Workers	25 rem/event	25 rem/event
Public	5 rem/event	25 rem/event (5 rem/event target)*

* BNFL has described the basis for the 5-rem target value in Appendix F of the SRD, Volume I. One of the reasons provided by BNFL for this lower numerical requirement is that the public should be protected by a lower exposure standard than a worker. The Regulatory Unit (RU) has accepted this lower value as the target dose standard.

In addition to the dose standards, the SRD addresses conformance with the Operations Risk Goal, the Accident Risk Goal, and the Worker Accident Risk Goal, which are presented as General Safety Objectives in DOE/RL-96-0006. These risk goals can be summarized as follows (RL/REG-98-01):

- The Operations Risk Goal limits the risk to the population (public and workers) in the area of the Contractor's facility from latent cancer fatalities. This goal has been equated to 2×10^{-6} fatal cancers per person per year.

- The Accident Risk Goal limits the risk to individuals from an accident within one mile of the controlled area from prompt fatality risks. This goal can be met by limiting doses from accidents to 100 rem or less. This goal has been equated to 4×10^{-7} prompt fatalities per year.

- The Worker Accident Risk Goal limits the risk to workers within the controlled area from fatalities due to radiological exposure from an accident. This goal has been equated to 10^{-5} fatal cancers per person per year.

There are distinct and important differences in the purpose of the TWRS-P dose standards and the TWRS-P risk goals. The purpose of the dose standards is to limit the potential radiation dose to any worker, co-located worker, or member of the public from normal operations and from each postulated accident event. The dose standards vary incrementally with the predicted frequency of the postulated event. The purpose of the risk goals is to limit the collective risk of normal operations and all potential accident events at the facility.

The dose standards and risk goals – in combination with ALARA design objectives, limits on effluent releases, and mandatory safety and defense-in-depth principles, and a regulated integrated safety management process – will ensure adequate safety for the TWRS-P facility. (The mandatory safety and defense-in-depth principles are specified in DOE/RL-96-0006 and further defined by the safety criteria and implementing standards of the SRD, part of the authorization basis.)

Calculation by BNFL that dose standards are narrowly met for particular credible accidents cannot be used as the basis to remove safety features required by the other parts of this program, specifically, the mandatory safety and defense-in-depth principles.

3.0 POSITION

It is the RU position that the accident dose standards established in the Contractor's SRD are appropriate as part of the contractual regulatory process that provides adequate safety for workers, co-located workers, and the public. This position is based on two considerations:

1. BNFL is required to implement a regulated integrated safety management process that will ensure adequate safety. The contractually required accident dose standards represent one component of the safety envelope required by this process. This process integrates these dose standards with the normal and anticipated event dose standards, ALARA objectives for normal and anticipated events, risk goals, limits on effluent releases, and mandatory safety and defense-in-depth principles.

2. Applicable regulations and guidance, discussed below, indicate that 25 rem is an appropriate accident dose standard for facility workers and co-located workers from Unlikely Events and Extremely Unlikely Events. Also, applicable regulations and guidance indicate that 5 rem is an appropriate target accident dose standard for individual members of the public from Extremely Unlikely Events.

4.0 ANALYSIS

The following subsections provide analysis supporting the positions described above in Section 3.0, including discussion of the accident analysis process and justification for the dose standards.

4.1 Relationship Between the Dose Standards and the Accident Analysis Process

This section presents key considerations that support the RU position that the actual doses associated with potential accidents at the facility will be well below the TWRS-P dose standards.

4.1.1 The SRD required accident analysis process ensures that the calculated doses associated with accidents will be less than the dose standards

In Appendixes A and B to the SRD, Vol. 2, BNFL established criteria to determine whether an important-to-safety SSC must also meet the single failure criterion. These criteria are similar to the DOE standard evaluation guidelines that are commonly used to determine whether or not a particular SSC should be "safety-class" as defined by the DOE Order system. The criteria are based on a comparison of the unmitigated accident consequences to the dose standards. These criteria also require that hazard control strategies be sufficiently robust to reduce the frequency of all postulated accidents below the accident dose standards, using conservative calculations. Moreover, those unmitigated accidents with a calculated dose greater than 25 rem for workers and co-located workers, or 5 rem for the public, must reduce the frequency of the event below 10^{-6} events per year, using conservative calculations to demonstrate the efficacy of the control strategies for improving SSC performance.

These criteria provide one means of ensuring that the consequences from most postulated accidents will be significantly below the dose standards. For example, consider an accident defined by an unmitigated dose of 5 to 25 rem to a worker and co-located worker. The dose standards for workers and co-located workers allow 25 rem/event in the Unlikely Event (10^{-2} to 10^{-4} events per year) category, but the SRD required accident analysis process requires events having unmitigated dose consequences of 5 to 25 rem to have sufficient SSC control strategies to occur less frequently than 10^{-4}. (Also, mitigated event frequency and consequence are required to be conservatively estimated, as described in the following section.)

4.1.2 The SRD required accident dose standards use a documented, conservative analysis methodology

The Contractor-derived dose standards include specific requirements that the actual radiation doses associated with accidents will be significantly less than the doses calculated to demonstrate compliance with the standards. The SRD states (Table 2-1, Footnote 3):

> "In addition to meeting the listed exposure standards for accidents, BNFL's approach to accident mitigation is to evaluate accident consequences to ensure that the calculated exposures are far enough below standards to account for uncertainties in the analysis, and to provide for sufficient design margin and operational flexibility."

In accordance with the above requirement, BNFL will use conservative dose assessment methods in demonstrating compliance with the dose standards. This approach provides one method of ensuring that actual accidents would result in actual doses to workers and co-located workers that are significantly less than 25 rem. As discussed above, the SRD requires that mandatory safety and defense-in-depth principles be met.

4.1.3 TWRS-P dose standards protect the public, workers, and co-located workers

It is appropriate that the TWRS-P dose standards protect the public somewhat more than workers and co-located workers. BNFL established a "target" dose of 5 rem for the public that is more protective than the 25-rem standard for both workers and co-located workers in the Unlikely Event and Extremely Unlikely Event categories. This action by BNFL recognized the fact that the public and co-located workers should not be treated similarly in safety analyses (SRD, Appendix F, Section 3.4).[2] Also, the protection of co-located workers to a standard of 25-rem implies a much lower likelihood of exposure to the public, considering the relatively large distance to the nearest possible member of the public (approximately six miles from the facility) at the Hanford Site. Similarly, even though the dose standards for the worker and the co-located worker for accidents have been selected by BNFL to be the same, the greater separation of the co-located worker will imply a lower likelihood of exposure to the co-located worker.

4.2 Justification for the Dose Standards

This section discusses the applicable nuclear safety regulations and guidance documents that support the RU's acceptance of the 25-rem dose standard proposed by BNFL for Unlikely Events and Extremely Unlikely Events for both workers and co-located workers. These regulations and guidance also support the 5-rem and 25-rem dose standards for the public in the Unlikely and Extremely Unlikely Event categories contractually established in DOE/RL-96-0006.

4.2.1 Comparison with proposed U.S. Nuclear Regulatory Commission (NRC) standards for licensing of new facilities containing special nuclear material (Draft 10 CFR 70, "Domestic Licensing of Special Nuclear Material")

The NRC's proposed revision to 10 CFR 70 and the companion NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*, prescribe accident dose standards for non-reactor nuclear facilities containing special nuclear material licensed by the NRC. The scope of this document includes nuclear waste vitrification plants such as the TWRS-P facility. In NUREG-1702, *Standard Review Plan for the Review of a License Application for the TWRS-P Project*, the NRC stated that acceptability of the application should be based on reasonable assurance that the facility will meet the 10 CFR 70 standards. The proposed 10 CFR 70 standards are slightly less restrictive than the TWRS-P dose standards. Specifically, the NRC standard for mitigated accidents in the 10^{-2} to 10^{-5} frequency range is 25 to 100 rem for workers. This means that to receive an NRC license, the applicant must demonstrate that mitigated accidents having estimated doses of 25 to 100 rem must have frequencies no greater than 10^{-2} per

[2] The SRD states that "The philosophy is that the public should be protected by a lower exposure standard than a worker. This philosophy recognizes the fact that the worker has agreed to work on the Hanford Site and has received training for avoiding hazards and dealing with hazardous situations."

year. For postulated accident sequences with probabilities less than 10^{-5} per year, there is no dose standard. In contrast, the TWRS-P dose standard for workers is 25 rem or less in the probability range 10^{-2} to 10^{-6}. The NRC standard for accidental doses to workers is less restrictive than the TWRS-P standard because it permits doses to be four times greater. Both the NRC and TWRS-P dose standards require conservative assumptions in the calculation of doses for the purpose of demonstrating conformance with the standards. (However, there is no qualitative standard specifying the required degree of conservatism in either the NRC or the TWRS-P regulatory process. Consequently, the impact of NRC dose limits versus the impact of TWRS-P standards on the TWRS-P design may be slightly different because of different interpretations of adequate conservatism.)

For members of the public, the dose standard in 10 CFR 70 is 5 to 25 rem in the 10^{-2} to 10^{-5} frequency range. In contrast, the TWRS-P dose standard is less than 5 rem in the 10^{-2} to 10^{-4} frequency range and 25 rem or less (with a 5-rem or less target dose) in the 10^{-4} to 10^{-6} range. Here again, the TWRS-P standard is more restrictive than the NRC standard.

The NRC dose standards in 10 CFR 70 do not explicitly address co-located workers. However, if the NRC considers co-located workers as members of the public (a position that is inconsistent with the position of both RL/REG-98-18, *Regulatory Unit Position on Radiological Safety for Hanford Co-located Workers*, and DNFSB/TECH-20, *Protection of Collocated Workers at the Department of Energy's Defense Nuclear Facilities and Sites*, the TWRS-P dose standards would still be slightly more restrictive than the NRC standards. Specifically, the dose standard in 10 CFR 70 is 25 rem to a member of the public in the probability range 10^{-2} to 10^{-5}, with no limit for less likely accidents. In contrast, the TWRS-P dose standard is 25 rem to a co-located worker in the probability range 10^{-2} to 10^{-6}.

4.2.2. Comparison with EH-12-94-01, *Method for the Assessment of Worker Safety Under Radiological Accident Conditions at Department of Energy Nuclear Facilities*

This report provides information on acceptable processes to evaluate worker safety and, in an appendix, provides a summary of "published or proposed guidelines of radiological consequence versus accident frequency." At existing DOE sites and facilities, the DOE Order system provides these guidelines for both the public and workers in order to classify SSCs as safety-class SSCs. (Safety-class SSCs are generally required to have more robust control strategies.) The guidelines are not to be used as design acceptance criteria nor to justify reduction in defense in depth, based on calculation that the criteria have been met without safety-class SSCs.

The referenced report was cited in the Contract (via DOE/RL-96-0006) as relevant guidance for the development of worker and co-located worker dose standards for Unlikely Events and Extremely Unlikely Events.

Although the report does not endorse specific guidelines for existing DOE sites and facilities nor provide TWRS-P dose standards, it does present summaries of values used or proposed for guidelines at various DOE facilities. These summaries indicate that the dose guidelines of 25 rem for workers and co-located workers in the Unlikely Event and Extremely Unlikely Event categories and for the public in the Extremely Unlikely Event category (with a 5-rem/event target) are appropriate at existing DOE facilities. For example, the 25-rem TWRS-P dose standard for the public is similar to a guideline proposed by DOE Office of Assistant Secretary

for Defense Programs (DP). The DOE-DP guideline is based on facility siting criteria found in 10 CFR 100, "Reactor Siting Criteria," and the superseded DOE Order 6430.1A, "General Design Criteria." For co-located workers, DOE-DP proposed slightly higher doses for Extremely Unlikely Events (100 rem versus 25 rem). However, the guidelines used at DOE sites for co-located workers in this category were centered around 25 rem. (That is, the DOE-DP guideline appears slightly higher than the values actually used as guidelines in corresponding DP safety analysis documentation.)

Thus, the TWRS-P accident dose standards for workers, co-located workers, and the public are generally consistent with the guidance and information provided in EH-12-94-01. This conclusion was one of the original justifications for accepting the Contractor-derived RESW dose standards established in RL/REG-98-01.

4.2.3 Emergency Exposure Guidelines for Workers Promulgated by the DOE (10 CFR 835, "Occupational Radiation Protection") and NRC (10 CFR 20, "Standards for Protection Against Radiation")

Both DOE and NRC regulations for protecting workers from radiation allow an additional dose of 25 rem for unusual situations. Specifically, both regulations permit five "planned special exposures" of up to 10 rem per year during a worker's lifetime. This equates to a lifetime total allowance of 25 rem for unusual situations above the 5 rem per year dose limit. Thus, both DOE and NRC regulations suggest that a single additional dose of 25 rem above the occupational limits does not present an undue risk to workers.

4.2.4 National Council on Radiation Protection and Measurements (NCRP)

The NCRP has stated that an occasional dose or once-in-a-lifetime dose of 25 rem does not present a significant risk to a radiation worker (*Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure*). This statement continues to serve as the basis for the 25-rem value found in many NRC regulations, including the 25-rem siting criterion cited in 10 CFR 100. The TWRS-P Contract established this dose standard because DOE desired that the hazard to the public from the proposed nuclear waste vitrification facility be roughly comparable to the hazard from comparable NRC licensed facilities. As noted above, BNFL has chosen to establish a 5-rem target dose standard for the public, and the RU has accepted this standard as part of the authorization basis.

4.2.5 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste"

The TWRS-P contractual dose standard for the public in the Unlikely Event frequency range of 10^{-2} to 10^{-4} is #5 rem/event with an explanatory footnote stating "10 CFR 72.106, Control area of an independent spent fuel storage installation or monitored retrievable storage facility." Section 72.106 provides requirements for the controlled area of an independent spent fuel storage installation (ISFSI) or of a monitored retrievable storage installation (MRS). Section 72.106(b) states:

> "Any individual located on or beyond the nearest boundary of the controlled area shall not receive a dose greater than 5 rem to the whole body or any organ from any design basis accident. The minimum distance from the spent fuel or high-level radioactive waste handling and storage facilities to the nearest boundary of the controlled area shall be at least 100 meters."

The regulation defines the term "controlled area" in §72.3 to mean "that area immediately surrounding an ISFSI or MRS for which the licensee exercises authority over its use and within which ISFSI or MRS operations are performed." Section 72.3 also defines the term "design bases." Part of the definition states that the term means "information that identifies the specific functions to be performed by a SSC of a facility … for achieving functional goals or requirements derived from analysis … of the effects of a postulated event under which the SSC must meet its functional goals." The 5-rem limit was therefore chosen for accidents in the Unlikely Event frequency range. The contractual dose standard represents the most restrictive accident dose standard for a member of the public promulgated by the NRC at a nuclear facility of roughly comparable hazard.

4.2.6 Criteria Used in Safety Analysis at TWRS Tank Farms

Comparison of the radiological risk guidelines used in the TWRS Tank Farms safety analysis with the TWRS-P dose standards is difficult because of a considerably different accident analysis methodology. Also, the values selected for the TWRS Tank Farm guidelines were slightly lower than typical DOE guidelines discussed in 4.2.2 above. For example, for Extremely Unlikely Events, the Tank Farm dose guideline was 10 rem onsite limit (no distinction between workers and co-located workers).

At the TWRS Tank Farms, guidelines were used in the evaluation of design-basis accidents to identify the set of safety-class and safety-significant SSCs and technical safety requirement (TSR) controls (HNF-SD-WM-SAR-067, *Tank Waste Remediation Systems Final Safety Analysis Report*). An analysis was performed in which no credit was taken for preventive or mitigative controls; radiation doses from an unmitigated accident were calculated at defined locations to the maximum onsite and offsite individuals. The results of the analyses without control measures were compared with the guidelines. If the guidelines were exceeded, safety SSCs and TSR controls that reduce the event frequency or consequences and ensure the guidelines are met were identified.

The significant difference in accident analysis methodology is that at the Tank Farms the mitigated accident analyses assumed the as-built identified preventive controls (i.e., event frequency-reducing controls) functioned as intended. For the same analysis, mitigative controls (i.e., consequence-reducing controls) were assumed to have some probability of failure. In the TWRS-P accident analyses, conservative estimates of the failure probability of both mitigative and preventive controls must be accounted for in the determination of whether the dose standard has been met, in addition to the satisfaction of risk goals and mandatory safety and defense-in-depth principles, as discussed above.

4.2.7 Comparison with Guidelines in DNFSB/TECH-20

The RU considers the TWRS-P dose standards, risk goals, and the BNFL accident analysis process to be consistent with the principles outlined in the DNFSB document. The document emphasizes that co-located workers and members of the public should be treated differently at DOE sites, in large part because of the relatively large distances to the site boundary. Although a 25-rem dose standard has been established for co-located workers and a 5-rem target dose standard for members of the public in the Extremely Unlikely Event category, it is expected that the facility design will result in significantly lower risks to the general population than to co-located workers in the vicinity of the facility. This will occur because the SSCs incorporated into the design in order to meet the dose standards for workers and co-located workers will also serve to protect the public. Because of the large distances to the Hanford Site boundary, the doses to members of the public from accidents will be much lower than the doses to co-located workers who may be much closer to the facility (i.e., they are typically conservatively assumed to be 100 meters from the facility). Consequently, the target dose standard of 5 rem to a member of the public will ***not*** be approached once the facility design has been established.

5.0 CONCLUSIONS

The DOE regulatory approval process requires that BNFL follow a process for identifying SSCs that are important to safety. The TWRS-P dose standards address normal operations and accidents; their purpose is to limit the radiation dose from normal operations and a single credible accident event to workers, co-located workers, and the public. The purpose of the General Safety Objectives, including the Operations Risk Goal, Accident Risk Goal, and Worker Risk Goal, is to define goals for the overall risk from facility operations including the risk from multiple potential accidents. In addition, BNFL's approach to safety integrates ALARA design objectives, limits on effluent releases, and mandatory defense-in-depth principles for identifying SSCs that are important to safety. BNFL has committed to a process that ensures that the actual risks from postulated accidents are much lower than the standards. Such an approach is necessary to meet the overall facility risk goals and to ensure that compliance with the dose standards is evaluated using an appropriate measure of conservatism to provide for sufficient design margin and operational flexibility.

In the RU's evaluation of the Contractor-derived RESW dose standards for workers under accident conditions (RL/REG-98-01), the RU concluded that the proposed standards:

> "Provide for an adequate level of safety and ensure that cost-effective safeguards affecting unlikely events will be evaluated (and incorporated as appropriate) consistent with the optimization approach embodied by the ALARA principle."

There is sufficient basis in relevant regulations and guidance to support the RU's acceptance of the TWRS-P accident dose standards. If the RU were to require dose standards less than 25 rem for workers and co-located workers in the Unlikely Event range or less than 25 rem for the public in the Extremely Unlikely Event range, this could put undue emphasis on lowering doses or probabilities for events that are unlikely to occur. The result could be that the limited probability of such events would be not be appropriately taken into account when balanced

against normal or anticipated events or when balanced against the pre-existing risks associated with the Tank Farms.

When comparing the TWRS-P dose standards to the dose standards in the proposed 10 CFR 70 and selected other documents, it might be suggested that the TWRS-P dose standards for workers and co-located workers are too ***low***, especially in the Extremely Unlikely Event category. However, a key consideration is that BNFL selected these standards voluntarily as part of the TWRS-P standards selection process. Although the RU has pointed out in its previous evaluations of these standards that higher values were not necessarily unacceptable, the RU had no reason to reject the standards selected by BNFL. If BNFL were to subsequently discover that the selected standards were too restrictive and could show that the standards resulted in overly conservative or costly SSCs, procedures exist by which they can request a revision to the standards.

6.0 REFERENCES

10 CFR 20, "Standards for Protection Against Radiation," *Code of Federal Regulations*, as amended.

10 CFR 70, "Domestic Licensing of Special Nuclear Material," *Code of Federal Regulations*, Proposed Rule, 1999.

10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," *Code of Federal Regulations*, as amended.

10 CFR 100, "Reactor Siting Criteria," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

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7.0 LIST OF TERMS

ALARA	as low as reasonably achievable
BNFL	BNFL Inc.
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DP	Office of Assistant Secretary for Defense Programs
ISFSI	independent spent fuel storage installation
MRS	monitored retrievable storage (installation)
NCRP	National Council on Radiation Protection and Measurements
NRC	U.S. Nuclear Regulatory Commission
RESW	Radiological Exposure Standard for Workers Under Accident Conditions
RU	Regulatory Unit
SRD	Safety Requirements Document
SSCs	structures, systems, and components
TSR	technical safety requirement
TWRS-P	Tank Waste Remediation System Privatization

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