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History Sheet

Rev	Date	Reason for revision	Revised by
0	21 Sep 2001	Supersedes Appendix A of BNFL-5193-ISAR-01 Rev 3. Incorporates 24590-WTP-ABCN-ESH-01-017 Rev 0 changes (contractor-approved ABCN).	J Duke

ISMP Section 3.3.1.3, "Safety Analysis Reports", states: "Those portions of the ISAR that relate to the fundamental aspects of design are considered to be part of the authorization basis." This volume of the ISAR is a list of the wording in Volume I that is considered to be Fundamental Aspects of Design. The first occurrences of the design descriptions in the ISAR that are considered to be Fundamental Aspects of Design, are identified section by section.

This volume is the only portion of the ISAR that is maintained current under authorization basis change control.

Below are the verbatim portions of the ISAR that constitute the fundamental aspects of design.

1.0 General Information

The LAW stream would then be vitrified into borosilicate glass, poured into containers, After dewatering, aluminum and other selected solids are leached from the HLW stream using caustic reagent if warranted. The pretreated HLW stream is vitrified and poured into canisters to solidify.

The LAW and HLW waste stream will be received from lines running from a new valve pit to be constructed by DOE near the AP tank farm.

1.1.1 Facility Description

The River Protection Project – Waste Treatment Plant, formerly the TWRS-P Facility, for treating the HLW and LAW includes the following major structures:

1) Process buildings
   a) Pretreatment Building(PTB)
   b) LAW Pretreatment Plant (LPP)
   c) LAW Vitrification Building
   d) HLW Vitrification Building
2) Wet chemical store
3) Glass formers store
8) HLW Failed Melter Store
9) Central Waste Stores
10) Spent Melter Staging

Buildings house the primary process cells or provide for transfer or storage of hazardous and radiological materials.

1.1.1.1 Process Buildings

1.1.1.1.1 Pretreatment Building (PTB)

- Receives LAW/HLW feeds
- Concentrates LAW feed

- Removes feed entrained solids from the LAW
- Removes Sr/TRU from solution, if necessary
- Removes Cs from LAW feed
- De-waters HLW feed
- Leaches Aluminum and other selected solids from HLW stream
- Blends HLW solids with Cs/Tc/Sr/TRU/ entrained solids from LAW feed and transfers to HLW Vitrification
- Processes HLW feed liquids as LAW feed

1.1.1.1.2 LAW Pretreatment Plant (LPP)

- Receives processed LAW feed from PTB
- Removes Tc
- Further concentrates the LAW Melter feed
- If applicable, blends entrained solids previously removed from LAW feed with the concentrated Melter feed for transfer to LAW Vitrification

1.1.1.1.3 LAW Vitrification Building

- Receives pretreated LAW feed from LPP
- Vitrifies it to produce glass for return to DOE

1.1.1.1.4 HLW Vitrification Building

- Receives pretreated HLW feed from the PTB
- Vitrifies it to produce glass for return to DOE

A shipping container handling area is provided.

1.1.1.2 Wet Chemical Store

The wet chemical store building is subdivided into an ion-exchange resin storage area and a bulk chemical reagent storage area. The ion-exchange resin storage area is enclosed by walls and has environment controls to prevent damage to the stored materials. The bulk chemical reagent storage area is covered with a roof to protect the chemicals from the weather. The bulk chemicals are stored in tanks within spill retention basins.

1.1.1.4 Glass Formers Store

The glass former store provides for receipt, storage, weighing, and blending of the bulk glass-making chemicals.

1.1.1.8 HLW Failed Melter Storage

The HLW failed melter storage area will be used to store HLW melters and have the flexibility to contain routine secondary wastes. Spent HLW melters may also be stored here.

1.1.1.9 Central Waste Stores

The Central Waste Storage Area will be used to store the routine secondary wastes from all the process buildings including mixed low level radioactive waste and consumable wastes from the HLW and LAW melters.

1.1.1.10 Spent Melter Staging

The spent melter staging area will be used to stage spent LAW melters for shipment and allows the flexibility to contain routine secondary wastes. Spent HLW melters may also be stored here.

1.1.2.2 RPP-WTP Processing Operations

The RPP-WTP Facility provides for treating LAW and HLW. The RPP_WTP Facility chemical processes can be subdivided into nine distinct unit operations, which are described below. The overall process is a combination of semi-batch and batch unit operations comprised of the following operations:

1) Receipt of LAW Feeds - The feed batch received from the DOE and the dilute effluents from the PT process is mixed to ensure uniform consistency.
2) LAW Entrained Solids and Strontium/TRU Separation - The solids in the feed are concentrated. The slurry is then washed to reduce the sodium level in the entrained solids slurry to within acceptable limits. The filtrate from this operation is then fed to cesium removal. For Envelope C feed, the same equipment is used to precipitate strontium and TRU which is removed along with the entrained solids.
3) LAW Cesium Removal - Cesium is removed from the filtrate and the liquor passes to technetium removal.
4) LAW Technetium Removal - Technetium is also extracted. The liquid is evaporated and passed to the vitrification system.
5) LAW Vitrification - The LAW generated after technetium removal is vitrified in the final unit operation, the LAW melter. The waste is fed to melter systems to produce glass for return to DOE.
6) Receipt of HLW Feed - Envelope D receipt vessels are required to receive a slurry of waste solids.
7) HLW Dewatering - Pretreatment of the Envelope D feed is required to reduce the water content of the feed to the HLW melter.
8) HLW Vitrification - The separated cesium, technetium, and strontium/TRU intermediate products are immobilized in the HLW melter together with the concentrated Envelope D material.
9) HLW Washing – HLW solids are washed with caustic solution to reduce the mass of HLW feed prepared for Vitrification.

Figure 1-3 shows the HLW and LAW processes.

1.2.3 Site Location

The RPP-WTP Facility is to be constructed at the east end of the 200 East Area of the Hanford Site.

1.2.4 Type, Quantity, and Form of Waste Material

The DOE has classified these wastes into four separate envelopes: three LAW (Envelopes A, B, and C) and one HLW (Envelope D).

1) Envelope A - This envelope makes up the majority (approximately 90%) of the minimum order quantities. This envelope contains cesium and technetium at concentrations that result in the need for their removal to ensure that the LAW glass specification can be met.
2) Envelope B - This envelope contains higher concentrations of cesium than the Envelope A. Both cesium and technetium require removal to ensure that the LAW glass specifications are met. This envelope also contains higher concentrations of chlorine, chromium, fluorine, phosphates, and sulfates, which may limit the waste loading in the glass.
3) Envelope C - This waste envelope contains organically complexed strontium and TRUs that will require removal. Cesium and technetium also require removal to ensure that the LAW glass specifications are met.
4) Envelope D - This waste envelope contains a HLW slurry.

3.2.7 Maintenance Facilities and Equipment

The Pretreatment Building contains a remotely operated maintenance facility designed for specified maintenance activities.

Storage facility design addresses isolation or segregation of chemicals, flammability of lubricants and paint, qualification of parts and components, damage to components and supplies resulting from environmental effects, and control of radioactive materials.

3.3.6 Application of Graded QA to SSCs, Processes, and Activities

SSCs defined as Important-to-Safety for the RPP-WTP Facility include the following.

1) SSCs needed to prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards of Safety Criteria 2.0-1 and 2.0-2 and SSCs needed to prevent criticality. This set of SSCs includes both the front line and support systems needed to meet these exposure standards or to prevent criticality. This set of Important-to-Safety SSCs are designated as Safety Design Class.
2) SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that place frequent demands on, or adversely affect the function of, Safety Design Class SSCs if they fail or malfunction. This set of Important-to-Safety SSCs are designated as Safety Design Significant.

The processes for identifying the SSCs for each of the two groups of SSCs Important-to-Safety and the requirements assigned to each of the two groups are discussed in Appendix A of the Safety Requirements Document.

3.5.2.3 Facility and Equipment Design

Throughout the facility and equipment design process, careful attention is given to human factors and ergonomic practices.

Designs of control rooms and local control stations ensure that adequate instrumentation and controls provided clear and unambiguous indications of RPP-WTP Facility status so that operators can detect and correct off-normal conditions.

4.2.1.1 Process Building

Secondary waste streams are collected, sampled, analyzed, and returned to the DOE for treatment and disposal.

Gaseous effluents generated from processing the waste feeds are treated, sampled, analyzed, and discharged to the atmosphere through a stack.

The immobilization area includes remotely operated vitrification systems contained in concrete cells (LAW melters are contained in a steel confinement shell).

For HLW/LAW, the pretreatment area includes concrete cells that contain remotely operated equipment.

4.2.3.2. Operability, Reliability, Availability, Maintainability and Inspectability.

SSCs are designed and installed so that the operability can be demonstrated by tests and inspections during which the required safety function is maintained.

4.3.1.1 Waste Receipt

LAW Envelope A, B, or C feeds are transferred, in batches. Envelope D feeds are received into the receipt vessels, in batches.

4.3.2 Melter Offgas Treatment Systems

4.3.2.1 Film Cooler and Quencher

The purpose of the offgas treatment system is to process offgas such that, when it is discharged to the atmosphere, it does not exceed environmental discharge limits.

4.3.3 Process Vessel Vent System

The process vessel vent system routes the gaseous discharge from various vessels to the secondary off-gas treatment system.

4.3.6.1 Process Building HVAC

The waste treatment facility ventilation system is designed to provide pressure gradients between confinement zones in which the air flow cascades from the areas of low or no contamination to areas with the greatest potential of contamination.

The process vessels are maintained at a pressure less than the surrounding process cells.

4.3.7 Fire Protection System

The RPP-WTP fire protection system performs the following functions:

1) Detects and locates fires
2) Provides automatic and/or manual capability to extinguish fires

4.3.9.2 Standby Power

Standby power is provided on loss of offsite power. The electrical loads provided with standby power include those loads that can tolerate a short power interruption.

4.3.9.3 Uninterruptible Power Supply

Loads that must be provided a continuous source of electric power are powered by a battery-backed uninterruptible power supply.

4.3.9.6 Egress, Emergency Escape, and Essential Lighting Systems

4.3.9.7 Grounding System

A ground is furnished over the entire facility area to provide for personnel safety and facilities for grounding SSCs.

4.3.9.8 Lightning and Surge Protection

Electrical equipment and lines are protected where necessary with lightning arresters and voltage protection devices.

4.3.9.9 Safety Design Class Electrical Circuits

Electrical equipment, cable, and circuits identified as Safety Design Class, are physically separated from other equipment, cables, and circuits to increase their availability during a common mode failure.

4.3.10.1 Integrated Control System

The Control System provides monitoring and control of the chemical process equipment and mechanical handling systems.

4.6.4.1 Protection of Public Safety

The location of the public (i.e., offsite receptor) for the purpose of establishing compliance with Table 4-27 and the chemical release standard, is established at the most limiting exposure location along the near bank of the Columbia River, Highway 240, and a southern boundary as shown in Figure 4-2.

4.6.4.2 Protection of Worker Safety

The location of the workers is shown in Figure 4-30.

4.7.2.1.5 Mitigating Design Features

The cell ventilation is routed out of the facility through stack.

4.8 Controls for Prevention and Mitigation of Accidents

In selecting engineered and administrative controls for the protection of worker and public safety, preference is given to engineered features over administrative controls. Preference is also given to passive over active engineered features.

5.1 As Low as Is Reasonably Achievable (ALARA) Policy and Program

1) ALARA - Personal radiation exposure shall be maintained as low as reasonably achievable (ALARA).

Radiation exposure of the workforce and public during routine operation shall be controlled so radiation exposures are maintained well below regulatory limits and so that radiation exposure is balanced against commensurate benefit.

5.3.3 Facility Radiation Control Zones

The RPP-WTP Facility is designed as a heavily shielded facility to aid in controlling external occupational radiation exposures.

5.6 Ventilation Systems

The RPP-WTP Facility ventilation systems are used to confine airborne materials to the designated process areas and to protect facility workers and co-located workers.

This concept ensures air flows from uncontaminated areas toward the most contaminated process areas, avoiding the dispersion of radioactive contamination within the facility.

Except for the facility ventilation systems serving areas evaluated as having marginal potential for radiological contamination, process ventilation air streams are filtered before discharge to the atmosphere.

5.7 Air Sampling

Continuous air monitors (CAMs) are used in areas where an individual is likely to be exposed to airborne radioactivity exceeding the respiratory protection action level, or where there is a need to alert personnel to an unexpected increase in airborne radioactivity levels.

6.1.3 NCS Limits

Most of the fissile material in the incoming and outgoing waste streams; however, is dispersed throughout large volumes of the waste resulting in a low concentration of fissile material in the process at any one time.

8.3 Fire Protection Features and Systems

The process building is designed and constructed of noncombustible or limited combustible materials and complies with the standards of Type 1 construction as defined in NFPA 220, *Standard Types of Building Construction*.

The process building is subdivided into separate fire areas for the purpose of limiting the spread of fire. These fire confinement areas are separated by fire-resistance-rated barriers commensurate with the expected fire severity. Openings in these barriers are protected with automatic or fixed fire-resistance-rated closure devices such as doors, windows, dampers, or seals.

The ventilation system is designed to prevent the spread of heat and combustion products throughout the building in the case of fire.

9.4 Detection of Accidents

The RPP-WTP Facility is equipped with instrumentation designed to detect the initial indicators of off normal or accident conditions.

9.9 Description of the Emergency Operations Center

The EOC is designed to remain operational and life supporting for an extended period of time under accident conditions and maintain its structural integrity under various events, including natural phenomena.

9.10 Information Communicated and the Parties Contacted

A timely, reliable, and accurate communications system is important for notifications, since it supplies the framework for conducting response operations.

11.0 Deactivation and Decommissioning

In addition, the RPP-WTP incorporates provisions in the original design to facilitate deactivation and the final decommissioning.

Appendix 1A Overall Safety Approach

3.2 Standard Confinement Barrier Approach

The primary barriers that provide confinement are process vessels, piping, and a dedicated vessel ventilation system.

Cell structure and ventilation system (C-5) constitutes the second level of confinement.

A third barrier is provided by the operating corridor outside the cell together with another dedicated ventilation system to prevent radioactive or hazardous material entering operating areas and challenging worker safety.

Figure 1-1 RPP-WTP Facility Building (this figure has been deleted)

Figure 1-2. LAW-Only Process

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Figure 1-3. Simplified Process Flow Diagram

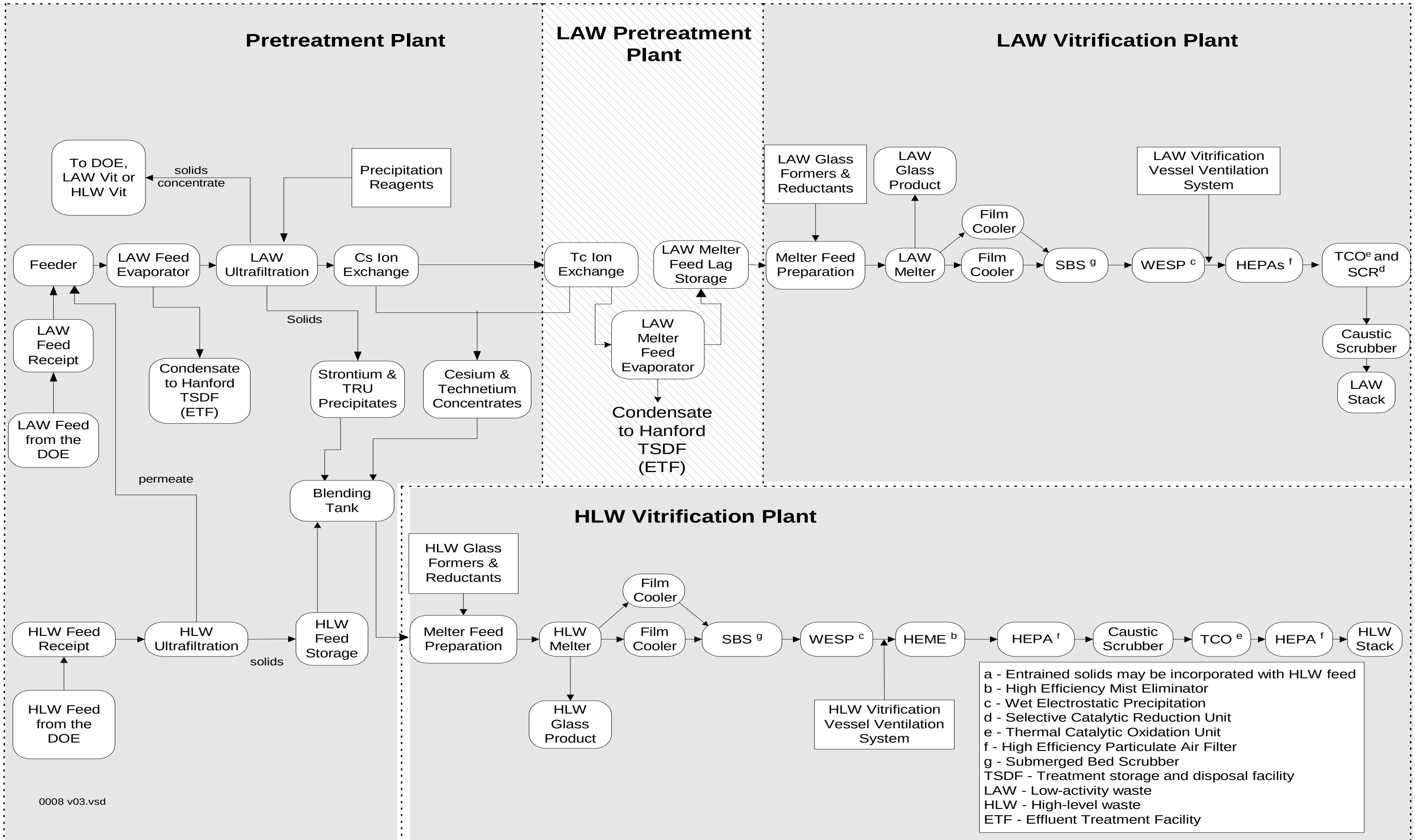

Figure 1-4. The Hanford Site, Surrounding Counties and Regional Highways

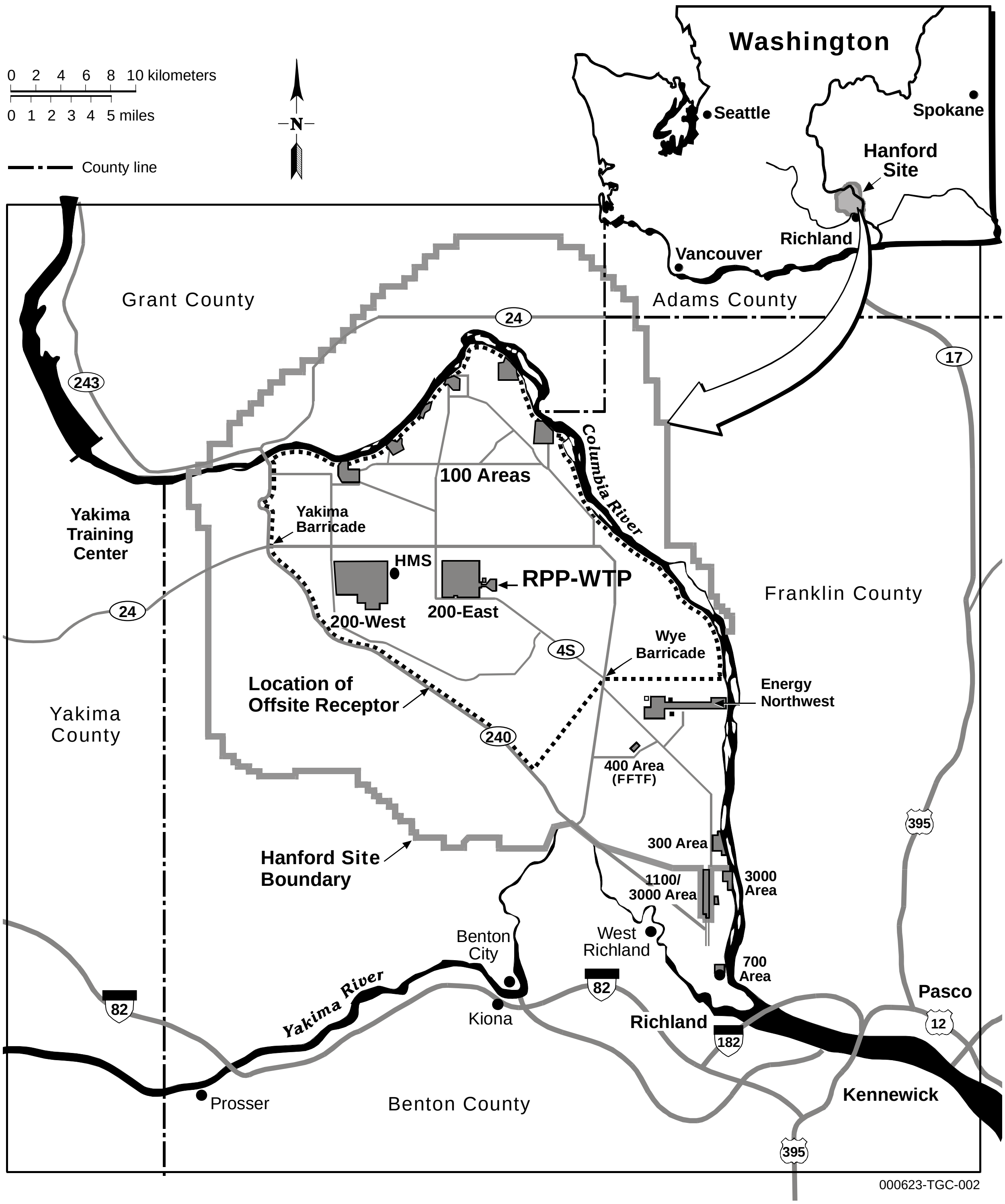

Table A-1. Radiological Exposure Standards Above Normal Background

Description	Estimated Frequency of Occurrence f (yr^{-1})	General Guidelines	Worker	Co-located Worker	Public
Normal Events: Events that occur regularly in the course of facility operation (e.g., normal facility operations)	Any Normal Event	Normal modes of operating facility systems should provide adequate protection of health and safety.	5 rem/yr 50 rem/yr any organ, skin, or extremity 15 rem/yr lens of eye 1.0 rem/yr ALARA design objective per 10 CFR 835.1002(b) (1)	5 rem/yr 1.0 rem/yr ALARA design objective per 10 CFR 835.1002(b) (1)	10 mrem/yr (airborne pathway) 100 mrem/yr (all sources) 100 mrem/yr (public in the controlled area) 25 mrem/yr (radioactive waste)
Anticipated Events: Events of moderate frequency that may occur once or more during the life of a facility (e.g., minor incidents and upsets).	$10^{-2}<f\leq10^{-1}$	The facility should be capable of returning to operation without extensive corrective action or repair.	5 rem/event (2, 3) 1.0 rem/event design action threshold (4)	5 rem/event (2, 3) 1.0 rem/event design action threshold (4)	100 mrem/event (3)
Unlikely Events: Events that are not expected, but may occur during the lifetime of a facility (e.g., more severe incidents).	$10^{-4}<f\leq10^{-2}$	The facility should be capable of returning to operation following potentially extensive corrective action or repair, as necessary.	25 rem/event (2, 3)	25 rem/event (2, 3)	5 rem/event (3)
Extremely Unlikely Events: Events that are not expected to occur during the life of the facility but are postulated because their consequences would include the potential for the release of significant amounts of radioactive material.	$10^{-6}<f\leq10^{-4}$	Facility damage may preclude returning to operation.	25 rem/event (2, 3)	25 rem/event (2, 3)	25 rem/event 5 rem/event target (3) 300 rem/event to thyroid
Location of Receptor			Within the RPP-WTP Controlled Area Boundary	The most limiting location at or beyond the RPP-WTP Controlled Area Boundary	The most limiting location along the near river bank/Hwy 240/southern boundary

(1) In addition to meeting the listed design objective of 10 CFR 835.1002(b), the inhalation of radioactive material by workers and co-located workers under normal conditions is kept ALARA through the control of airborne radioactivity as described in 10 CFR 835.1002(c).

(2) In addition to meeting the listed worker and co-located worker exposure standards for accidents, the Worker Accident Risk Goal is satisfied through the calculation of the risk from accidents with accident prevention and mitigation features added as necessary to meet the goal.

(3) In addition to meeting the listed exposure standards for accidents, the Project 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.

(4) When a calculated accident exposure exceeds this threshold, appropriate actions are taken. These include carrying out a less bounding (i.e., more realistic) evaluation to show that the accident consequences will be below the threshold or evaluating additional safeguards for cost effectiveness and/or feasibility. This threshold is not a limit; it does not require the implementation of additional preventative or mitigative features if they are not both cost effective and feasible.