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2.0	Compliance with Laws and Regulations	3	Deleted in its entirety, N/A*
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4.0	Standards-Based Management	3	Deleted in its entirety, N/A*
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6.0	Integrated Safety Management	3	Deleted in its entirety, N/A*
7.0	Regulatory Interfaces	3	Deleted in its entirety, N/A*
8.0	Document Control and Maintenance	3	Deleted in its entirety, N/A*
9.0	Scheduling of Safety-Related Activities	3	Deleted in its entirety, N/A*
10.0	Assessments	3	Deleted in its entirety, N/A*
11.0	Organization Roles, Responsibilities, and Authorities	3	Deleted in its entirety, N/A*
12.0	Definitions	3	Deleted in its entirety, N/A*
13.0	References	3	Replaced by new Section 2, N/A*

*Section was revised in its entirety; no revision bars are shown.

CONTENTS

1.0 Project Integrated Safety Management Approach

1.1 Purpose

This Integrated Safety Management Plan (ISMP) provides a top level description of the activities of the Hanford Waste Treatment and Immobilization Plant (WTP) Project contractor to integrate radiological, nuclear, and process safety practices and programs with engineering, operations, safety, and quality principles and practices for the design, construction, and commissioning of the WTP facility. The ISMP identifies how the WTP Project addresses the expectations of the Department of Energy (DOE) document DOE/RL-96-0003, *DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*, relative to the content of the ISMP document.

The ISMP is a road-map document that summarizes the Project approach to integrated safety management of activities related to supporting radiological, nuclear, and process safety and does not contain requirements. After summarizing the elements of integrated safety management relative to radiological, nuclear, and process safety, the ISMP directs the reader to these other Project authorization basis (AB) documents for commitments.

1.2 Introduction

The WTP Project (Project) safety approach involves identification and integration of appropriate safety criteria, design requirements, and safety management programs, relative to project hazards and accident analysis processes, to develop a safe facility design, as well as construct and commission the facility safely. This approach supports minimizing risk to the worker, the public, and the environment, while maintaining compliance with applicable laws and regulations, conforming to top-level integrated safety management principles, and providing a safe WTP.

The management practices that implement this safety approach are based on the application of experience that the WTP Project team has obtained from nuclear facility design, construction, and commissioning in commercial and government nuclear facilities and the chemical process industry. The facility that is designed and constructed as part of the design, construction, and commissioning (DC&C) contract is expected to incorporate provisions that fully address the needs of the operations and deactivation phases of the WTP.

The Project safety approach begins with the definition of work to be performed. By then developing the facility process flows, performing hazards identification and analyses, and determining hazard control strategies, the necessary standards, controls, and programs are determined which guide design of the facilities in a manner that meets applicable laws and regulations, DOE top-level safety requirements, and best industry practices.

The WTP Project *Safety Requirements Document* (SRD), 24590-WTP-SRD-ESH-01-001-02, and the WTP Project *Preliminary Safety Analysis Report* (PSAR), 24590-WTP-PSAR-ESH-01-002-01, (Volume I) for the WTP facilities provide detailed description and discussion of the safety criteria, design/safety analysis processes, and analytical results that are applied to WTP design, construction, and commissioning.

The DOE expectations for the ISMP, as part of the WTP Project Standards Approval Package, are presented in DOE/RL-96-0003, Section 4.1.2, Items 11, 12, and 13. Item 4.1.2.11 specifies the functional content requirements of the ISMP in eight elements (i.e., 4.1.2.11.a through 4.1.2.11.h). The DOE/RL-96-0003, Section 4.1.2, Items 11 content requirements for the ISMP are presented as follows.

"4.1.2.11. The Contractor's ISMP, which shall do the following:

- a *Define the key important-to-safety activities to be performed by the Contractor.*
- b *Specify the standards-based management processes to be used by the Contractor to ensure that radiological, nuclear, and process safety is adequately defined (i.e., tailored to the nature and level of hazards, including process hazards), implemented, and maintained.*
- c *Ensure that the Contractor is in compliance with DOE nuclear safety regulations, in conformance with the DOE-specified top-level safety standards and principles, and in compliance with the SRD.*
- d *Define the Contractor's interfaces with other regulatory regimes such as environmental protection, occupational safety, and safeguards and security and define the processes for resolving conflicting requirements at these interfaces and for ensuring safety adequacy at these interfaces (i.e., ensuring that safety "gaps" do not occur).*
- e *Specify the expected flow and schedule of the Contractor's important-to-safety work and deliverables, including interactions with the OSR.*
- f *Describe the self-assessment functions to be employed by the Contractor.*
- g *Describe the Contractor's approach for tailoring its radiological, nuclear, and process safety deliverables and actions commensurate with the nature and level of hazards associated with its waste processing activities.*
- h *Identify roles, responsibilities, and authorities for defining, implementing, and maintaining safety."*

Sections 1.3 to 1.10 of this plan summarize the approach the Project has taken to meet the integrated safety management requirements of the contract, as detailed in DOE/RL-96-003, relative to radiological, nuclear, and process safety. These ISMP sections 1.3 through 1.10 address each of the eight elements from DOE/RL-96-0003 Section 4.1.2, Item 11, respectively.

DOE/RL-96-0003, Section 4.1.2, Item 12, *"ISMP compliance with applicable laws and regulations"* and Item 13, *"ISMP conformance to the top-level radiological, nuclear, and process standards and principles"* require that elements of radiological, nuclear, and process integrated safety management used by the WTP Project be addressed by the ISMP.

The safety related programs, processes, and plans that support ISMP elements are identified as those necessary for being implemented to design, construct, and commission the WTP to reflect the following general principles of integrated safety management:

- line management responsibility for safety;
- roles and responsibilities clearly identified;
- competent personnel involvement;
- priorities established to assure project success;
- appropriate safety standards and requirements identified and approved;

- hazard controls tailored to the work;
- operations authorizations received and implemented; and
- affected organizations and personnel involved in all project phases.

1.3 Key Safety-Related Activities

The Project contract provides requirements for safety related activities and documentation that are to be provided to DOE as part of the authorization process for facility construction and commissioning. The Project schedules and submits these documents in a manner that addresses the expectations of DOE/RL-96-0003. The PSAR, Volume I, Chapter 17, *Management, Organization, and Institutional Safety Provisions*, Section 17.2 indicates the PSAR sections addressing key safety-related activities for the design, fabrication and construction, and commissioning phase that support specific authorizations and overall regulation of WTP activities by DOE.

1.4 Standards-Based Management Processes

The process of developing a safe design of the WTP is based on application of the approved standards in the SRD. These standards were identified as a flow-down from laws and regulations, industry codes and standards, contractual requirements, and commercial practices. The SRD implementing standards are reviewed and revised as appropriate as the analysis of hazards and consideration of operational features matures. The design process is conducted within a work-control framework consisting of approved plans and procedures that integrate the activities of the engineering, operation, and safety areas of expertise. These administrative processes ensure that the design effectively ties the description of work to be performed and the identification and analysis of the associated hazards to the SRD. The inter-relationship of the design process and the SRD to established programs that address nuclear and process safety, engineering and design, radiation protection, and quality result in a facility that is constructed and commissioned in a manner that will provide the necessary protection for the worker, the public, and the environment. The PSAR, Volume I, Sections 3.2 and 17.2 indicate PSAR sections addressing standards-based management processes. The SRD, Volume II, Appendices A, B, D, E, and I, and the Radiation Protection Program (RPP) document, Appendix A, subpart C, also provide descriptions of the standards-based management process.

1.5 Compliance with DOE Regulations and the SRD, and Conformance to Top-Level Standards

The Project compliance with laws and regulations is described and managed within the framework established by the *Quality Assurance Manual* (QAM), 24590-WTP-QAM-QA-01-001, (for 10 CFR 830, Subpart A), the *Radiation Protection Program*, 24590-WTP-RPP-ESH-01-001, (for 10 CFR 835), preliminary and final safety analysis reports (for 10 CFR 830, Subpart B) and a documented WTP Contractor program for identifying and evaluating off-normal events (for 10 CFR 820). The SRD has been derived from and is maintained in conformance with DOE top-level standards (to meet DOE/RL-96-0006, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor*).

The Project activities that are described and conducted under these documented programs are themselves managed under an established configuration management program, as addressed in QAM Policies Q-2.1, Q-5.1, Q-6.1, and Q-17.1, and, where facility authorization basis information is involved, a specific authorization basis maintenance process. These activities, as addressed in SRD Chapters 1, 3, 4, 5, and 6, ensure that the standards basis and regulatory process requirements are defined, disseminated through personnel training and management direction, and maintained in alignment through the duration of the DC&C contract. The PSAR, Volume I, Sections 6.2, 7.2, 9.2, 10.2, 11.2, 12.2, 13.2, 15.2, 17.2 and 18.2, indicate PSAR sections that provide additional discussion of Project AB management activities to address meeting laws, regulations, and top-level standards.

1.6 Regulatory Interfaces

The Project has established and maintains regular working interfaces with the DOE and organizations external to the Hanford DOE community, e.g., Washington Department of Ecology, to assure timely awareness, incorporation, and, if necessary, resolution of conflicts with the requirements of these organizations. Points of contact within the Project exist and provide proven and efficient path-ways for external regulators to maintain the necessary knowledge of the Project's design and regulatory processes, and identify and resolve any areas where facility design, construction, or commissioning activities may be impacted by the regulations of these organizations. PSAR, Volume I, Section 17.2 indicates PSAR sections that provide this regulatory interface discussion.

1.7 Flow and Schedule of Safety-Related Work and Deliverables

The Project maintains a work flow and scheduling process that addresses the activities and/or documentation necessary to meet DOE/RL-96-0003 expectations for providing to DOE those items that support its (DOE's) overall regulatory process and approvals of design, construction, and commissioning. The deliverables in these schedules cover the documents that are needed for DOE to provide authorization for design, construction, and commissioning activities. PSAR, Volume I, Section 17.2 indicates PSAR sections that provide discussion on flow and schedule of safety-related work and deliverables.

1.8 Self-Assessment

The Project uses a combination of self-assessment processes to provide senior management oversight and functional organization assessments to assure that provisions for public and worker safety, and protection of the environment are incorporated in the design, procurement, construction, and commissioning of the facility. Senior Project personnel provide an independent oversight function for Project management that meets the expectations of DOE/RL-96-0004, *Process for Establishing a Set of Radiological, Nuclear, and Process Safety standards and Requirements for the RPP Waste Treatment Plant Contractor*. This role, as implemented by the Project Safety Committee (PSC), includes providing continued assurance that the approved set of radiological, nuclear, and process implementing standards is appropriate to achieve the required safety. PSAR, Volume I, Section 17.2 indicates PSAR sections that provide discussion on self-assessment, including the PSC role.

The Project uses management assessments and independent assessments to provide feedback on overall performance and effectiveness of Project activities. Functional and/or Line managers conduct management assessments of the activities of their organizations in order to identify and correct problems hindering the organization from achieving its objective. This type of assessment is discussed in QAM Policy Q-18.3, *Management Assessment*, which addresses the purpose, implementation strategy, policy, conduct, and managers' responsibilities in the management assessment process.

Independent assessments are performed by personnel that are largely from the Quality Assurance organization, thereby reporting through a separate pathway to Project senior management. These assessments provide an independent look, from Functional and Line management, at the quality of performance of Project activities. This type of assessment is discussed in QAM Policies Q-18.1, *Independent Assessment (Audit)* and Q16.1, *Corrective Action*, which address the purpose, implementation strategy, policy, conduct, and managers' responsibilities in the independent assessment process.

1.9 Tailoring of Safety Related Documentation

Regulatory documentation developed by the Project is tailored to apply top-level safety regulations and standards to design, construction, and commissioning activities in a manner that is commensurate with the hazards involved with the specific task or activity to be performed. Aspects of the facility design or operation that are critical to safety, and the hazards associated with these facility features, are identified and the necessary controls determined to achieve the required safety performance. The Project has established policies and procedural practices tied to the various stages of the Project that guide and control the performance and products of the tailoring process. PSAR, Volume I, Section 17.2 indicates PSAR sections that provide discussion on tailoring, as it relates to the regulatory safety documentation that is developed by the Project contractor.

Management of safety documentation records developed as a part of the WTP Project safety management process is addressed by the WTP Project QA Program. The QA requirements for Project records management are provided in QA Manual Policy Q-17.1, "Quality Assurance Records", Policy Q-06.1, "Document Control", and Policy Q-05.1, "Instructions, Procedures, and Drawings".

1.10 Roles and Responsibilities

The WTP Project management for DC&C activities has established a policy that all Project personnel are responsible for ensuring the protection of the public, personnel on site, and the environment. The flow-down of safety management responsibility and accountability starts with the Project Director and extends through the management and supervisory chain to each worker including subcontractors. This flow-down is captured in programs, policies and procedures, communicated to the workforce through orientation and training, reinforced by group and individual performance evaluations, and monitored and assessed by independent oversight. AB document coverage for these line management roles and responsibilities is provided in the QAM, primarily in QAM Policy Q-01.1, *Project Organization*, in the SRD, Appendix I, Sections 5.2, 5,3, and 6.0, and in PSAR, Volume I, Section 17.2 that indicates PSAR sections that provide discussion on roles and responsibilities.

2.0 References

DOE/RL-96-0003, DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor

DOE/RL-96-0004, Process for Establishing a Set of Radiological, Nuclear, and Process Safety standards and Requirements for the RPP Waste Treatment Plant Contractor

DOE/RL-96-0006, Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor

WTP Project *Safety Requirements Document (SRD)*, 24590-WTP-SRD-ESH-01-001-02

WTP Project *Quality Assurance Manual* (QAM), 24590-WTP-QAM-QA-01-001

WTP Project *Radiation Protection Program* (RPP) document, 24590-WTP-RPP-01-001

WTP Project *Preliminary Safety Analysis Report (PSAR)*, Volume I, "General Information" 24590-WTP-PSAR-ESH-01-002-01

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0b	13 June 2003	Incorporates 24590-WTP-ABAR-ENS-02-001, Rev 0, as approved by DOE Letter 03-OSR-0178 (CCN 059880) and 24590-WTP-SE-ENS-03-169, Rev 0, as approved by the Contractor.	L. Dougherty

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2.0	Facility Description	0	N/A
3.0	Hazard and Accident Analyses	0b	3-1, 3-2, 3-15 through 3-18, 3-30
4.0	Important to Safety Structures, Systems, and Components	0b	4-2
5.0	Derivation of Technical Safety Requirements	0	N/A
6.0	Criticality Safety Program	0	N/A
7.0	Radiation Protections	0b	7-1 through 7-4
8.0	Hazardous Material Protection	0	N/A
9.0	Waste Management	0	N/A
10.0	Initial Testing, In-Service Surveillance, and Maintenance	0	N/A
11.0	Operational Safety	0	N/A
12.0	Procedures and Training	0b	12-2
13.0	Human Factors	0	N/A
14.0	Quality Assurance	0b	14-1
15.0	Emergency Preparedness	0	N/A
16.0	Deactivation and Decommissioning	0b	16-1
17.0	Management, Organization, and Institutional Safety Provisions	0b	17-1 through 17-39
18.0	Fire Safety Program	0	N/A

Contents

3 Hazard and Accident Analyses

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3 Hazard and Accident Analyses

3.1 Introduction

This chapter describes the hazard and accident analyses methodology. The purpose is to provide an overview of the process used to systematically identify hazards and evaluate potential internal, external, and natural phenomena events that can cause the identified hazards to develop into accidents. The results of this process are provided in facility-specific volumes. The facility-specific volumes identify any unique methodologies used in their development that differ from the general process described in this chapter. Based on the hazard analysis process, representative design basis events (DBEs) are selected for in-depth accident analysis. The DBE represents a bounding case for a category of events. The hazard and accident analysis process identifies safety standards and requirements that, when implemented, ensure the River Protection Project - Waste Treatment Plant (WTP) can be operated safely, complies with applicable laws and regulations, and conforms to top-level safety standards and principles stipulated within the DOE document *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors* (DOE/RL-96-0006).

Throughout this chapter, several codes are identified that are used in support of the hazard and accident analysis. These codes are verified and validated, and subject to software configuration management in accordance with *Use of Quality Affecting Software Applications*, 24590-WTP-GPP-IT-001.

3.2 Requirements

The principal requirements for the development of hazards and accident analyses are:

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Chapter 2.0	Radiological and Process Standards	Safety Criteria 2.0-1 and 2.0-2
Chapter 3.0	Nuclear and Process Safety	Safety Criteria 3.1-1, 3.1-3, 3.1-4, and 3.2-1
Chapter 9.0	Documentation and Submittals	Safety Criterion 9.1-7
Appendix A	Implementing Standard for Safety Standards and Requirements Identification	
Appendix B	Implementing Standard for Defense in Depth	
Appendix D	Radiological Exposure Standards for the RPP-WTP Project	

Integrated Safety Management Plan (ISMP; 24590-WTP-ISMP-ESH-01-001)

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 3
1.4	Process Hazards Analysis	3.3, "Hazards Analysis Methodology"
1.4	Facility Design/Development Activities and Safety Features Identification	3.3.3, "Identification of Control Strategies"
1.4	Classification of SSCs	3.3.8, "Classification of Systems, Structures, and Components"

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 3
1.4	Normal Operations	3.3, "Hazard Analysis Methodology"
1.4	Anticipated Operational Occurrences	3.4, "Accident Analysis Methodology"
1.4	Accident Analysis	3.3, "Hazard Analysis Methodology," 3.4, "Accident Analysis Methodology," and 3.5, "Hazard Classification"
1.4	Proven Engineering Practices	3.3.3, "Identification of Control Strategies" and 3.4.5, "Defense in Depth"
1.4	Passive Features	3.3.3, "Identification of Control Strategies" and 3.4.5, "Defense in Depth"
1.4	Active Features	3.3.3, "Identification of Control Strategies" and 3.4.5, "Defense in Depth"
1.4	Safety Systems Design	3.3, "Hazard Analysis Methodology," 3.4, "Accident Analysis Methodology," and 3.5, "Hazard Classification."
1.4	Tailoring Safety Management Processes	3.3, "Hazard Analysis Methodology"
1.4	Engineered Features	3.3.8, "Classification of Structures, Systems, and Components."
1.4	Process Safety Information	3.3.2, "Hazard Evaluation" and 3.3.2.1, "Identification of Hazards"
1.4	Process Hazards Analysis	3.3.2, "Hazard Evaluation" and 3.3.2.1, "Identification of Hazards"
1.4	Hazard Assessment, Controls, and Operating Conditions	3.3.2 "Hazard Evaluation"

3.3 Hazard Analysis Methodology

This section describes the methodology used to identify hazards and systematically evaluate event sequences. The hazard identification was performed for normal operations and considered anticipated operational occurrences, and accident conditions. Compliance with the SRD exposure standards for normal operations is accomplished through compliance with programs for radiation protection, hazardous material protection, and waste management as described in Chapters 7.0, 8.0, and 9.0, respectively. Compliance with the SRD exposure standards for anticipated operational occurrences and accident conditions is accomplished through compliance with the standards and requirements developed as a result the hazard evaluation and accident analyses methodology described in this chapter. The following project functions are included in the hazard analysis: feed receipt, pretreatment, low-activity waste immobilization, high-level waste immobilization, laboratory analysis, product and secondary waste handling, and the balance of facilities.

The WTP project utilizes a defined process for the performance of hazard analysis. This process is described in SRD Appendix A for establishing a set of radiological, nuclear, and process safety requirements and standards for design, construction, and operation of the facility. The methodology referred to as the Integrated Safety Management (ISM) process includes the identification of the work, the evaluation of hazards related to the work, the identification of potential hazard control strategies, the selection of the preferred hazard control strategies, and the identification of standards and requirements. The confirmation of the selected set of standards is discussed in Chapter 4. The output from the ISM process is recorded in the Standards Identification Process Database (SIPD). The SIPD documents the comprehensive list of hazards based on analysis of the specific facility and process, incidents at similar facilities, and hazards identified in analyzing other facilities. The ISM process is iterative and continues throughout the life of the project. The SIPD is updated to keep the identified hazards current in response to the ISM process iterations that may result from changes in the WTP process, equipment, and design.

Figure 3-1 is a flow chart illustrating the ISM methodology used for the WTP Project.

3.3.1 Identification of Work

The aim of this activity is to describe work performed so the hazards inherent in the work can be identified and evaluated. Work activity experts from the engineering staff and operations staff who have extensive knowledge of the overall processing approach and are integrally associated with the facility design perform this activity.

In an overall sense, identification of work involves definition of the project mission and identification of the processes that must be performed to accomplish the mission. The identification of work includes selection of optimum functions, processes, and parameters through trade studies and definition of functional requirements. Identification of work for the purpose of design development involves definition of various plant systems, structures, and components (SSCs). This definition is the focus for the ISM teams created to conduct ISM on a plant system basis.

Figure 3-2 shows the inputs for the identification of work. The hazard analysis and design engineering leads for the area or group of systems to be studied assemble an information package that identifies the work to be studied by the integrated team. The lead for each system provides a summary of the system's functions. The package includes process flow diagrams, piping and instrumentation diagrams, mechanical handling diagrams, ventilation flow diagrams, facility layout drawings, system design description documents, trade studies, and design change applications relevant to the area of study. The form and quantities of the radioactive or otherwise hazardous materials (for example, chemicals) at risk are developed to ensure a complete information package is available.

The core ISM team consists of safety personnel, design personnel familiar with the specific design area being studied, and operations personnel to provide the operational input. Included in the core team are accident analysis assessors to aid in the team's understanding regarding the potential hazards and the control strategies to deal with the potential hazards. In addition to the core team, supporting specialists support the process or unit operation being studied (for example civil and structural engineers, criticality safety personnel, radiation protection experts, fire protection engineers, human factor experts, and process chemical specialists).

The qualifications and experience of all team members is an important factor for the ISM process. Auditable training records and resumes are maintained by the WTP project for all WTP project employees.

When the results of each of the ISM studies are entered into the SIPD, reference to the minutes of ISM meetings which contain a participant list of ISM team members involved, are linked in the SIPD to the records generated by those meetings. This allows identification of an ISM team member's involvement in specific WTP facility or design areas.

The outcome of the identification of work is contained in the facility-specific PSAR volumes as part of the hazard identification results. The identification of work activity is an iterative process. Identification of work will be reconsidered in light of design evolution, the outcome of hazard evaluations, and the development of hazard control strategies.

3.3.2 Hazard Evaluation

Per the ISM methodology presented in Figure 3-1, the hazard evaluation comprises the identification of hazards, the identification of potential accident/event sequences, estimation of accident consequences, and estimation of accident frequencies. The integrated teams conduct the hazard evaluation activity on a plant system basis. These teams include work activity experts as identified in section 3.3.1, hazard assessment experts, and hazard control experts.

Hazard assessment experts and hazard control experts are typically members of the technical staffs of the Safety Analysis Manager and the Regulatory Safety Manager. The Process Management Team provides additional technical resources as required to evaluate the hazards.

3.3.2.1 Identification of Hazards

The process hazard analysis technique evolves as the design matures. The appropriate technique is chosen by using methodology consistent with those recommended by the American Institute of Chemical Engineers (AIChE) in its *Guidelines for Hazard Evaluation Procedures* (AIChE 1992). As the design matures, the preferred technique is a Hazard and Operability Analysis (HAZOP) although other identification techniques from (AIChE 1992) are also used to fully identify the internal hazards associated with each area of the facility.

A systematic approach is used to compile the initial list of hazardous materials and energy sources associated with the facility processes, design, and operations. As part of the hazard identification process, the facility radioactive and chemical inventory information is documented (i.e., a hazard map). The inherent hazardous characteristics of the significant process chemicals and byproducts used are identified in the facility-specific PSAR volumes. Equipment normally containing hazardous (toxic or radioactive) material are listed with capacities and contents. Refer to the facility-specific PSAR volumes for a discussion of the specific material at risk for that facility. Based on the chemical inventory tables generated as part of this process, matrices have been constructed to aid in the identification of interactions among materials, energy sources, and environmental conditions. The matrices are identified in the facility-specific PSAR volumes as an aid in determining the compatibility of the process reagents with each other, the waste steams, and process byproducts. The matrices are used as a tool to ensure comprehensive coverage of processes, systems, and operations across multiple locations.

The results of the hazard identification for the WTP facilities are presented in the facility-specific PSAR volumes. The inventories of radioactive and other hazardous materials in the facilities are presented in tabular form. The material inventories are derived from feeds with radionuclide concentrations at the contract maximum values, except for additional restrictions placed on ^{125}Sb and ^{241}Am (AZ-101 and

AZ-102). As such, they bound the inventory that may be present in the facility. These materials include the planned process chemicals and expected byproducts of the process. For the potentially hazardous chemicals, information about the material properties, and the nature of the potential hazard are also tabulated based on the input of engineers with overall knowledge of the analysis area layout and equipment, in cooperation with one or more safety engineers. Based on the identified work and considering the results of the hazard identification, potential accidents (hazards and hazardous situations) that could result in an uncontrolled release of hazardous material or energy are systematically identified.

3.3.2.2 Identification of Potential Accident/Event Sequences

The ISM process is applied to the WTP by facility and design area, with a different ISM team assembled for each area. An area may consist of a number of related systems. For instance, receipt and blending systems include waste receipt and transfer systems, glass former receipt and transfer systems, feed preparation and melter feed systems, and the feed sampling system. In some cases, a plant area is subdivided into smaller groups of systems to facilitate the study.

As identified in section 3.3.2.1, a variety of techniques are used to fully identify the internal hazards associated with each area of the facility. For each hazard identified, the ISM team develops initiator and hazardous situation statements. The initiator identifies the potential process upset or failure (for example "steam injector supply valve malfunction results in continued steam flow after V12004A/B is empty"), and the hazardous situation identifies the potential uncontrolled release of hazardous material or energy (for example, "Aerosol generation in receipt vessel exhausts into the vessel vent system resulting in potential for airborne release"). Together, these statements represent a potential accident sequence for the ISM team to further evaluate.

In addition, a survey of hazard assessments and operating experience of waste vitrification facilities similar to the WTP was conducted in order to provide a useful resource and to verify the completeness of the currently identified accident/event sequences. Other waste vitrification facilities that were examined for comparison purposes include the Savannah River Site defense waste processing facility and the West Valley Demonstration Project. In addition, individuals familiar with the operations and design of these facilities are included on the ISM teams.

The results of the accident/event sequence identification process are located in the facility-specific volumes of the PSAR, as part of the hazard evaluation results.

3.3.2.3 Estimation of Accident Consequences (Severity Levels)

While examining these hazards, the ISM team evaluates the potential consequence to facility workers, co-located workers, and the public. The consequence information recorded in the SIPD can also be used to examine the potential for releases to the environment. The estimated consequences are based on bounding unmitigated evaluations. Any assumptions implicit in the consequence estimates are recorded in or referenced by the SIPD records.

For radiological consequences, a severity level (SL) is assigned to reflect the unmitigated consequence of the postulated accident based on the experience of the ISM team members. Where quantitative evaluations are used to determine severity levels, the methodology in 24590-WTP-GPG-SANA-004 is used. The unmitigated consequences do not account for structures, systems, and components (SSCs) that serve to prevent or mitigate the release. Table 3-1 shows the severity level definitions based on SRD Appendix A.

For hazardous chemical consequences, the postulated consequences are evaluated against the standards, or threshold values, identified in SRD Safety Criterion 2.0-2. Specifically, these are:

- Releases exposing the offsite public to Emergency Response Planning Guide (ERPG) ERPG-2 concentrations
- Releases exposing the co-located worker to ERPG-3 concentrations
- Accidents affecting the facility worker that could cause in-patient hospitalization of at least 3 facility workers, or at least a single fatality

Where ERPG values have not been published, the DOE Temporary Emergency Exposure Limits (TEELs) may be used as substitute ERPGs. For each hazardous situation, a determination is made for each receptor (public, co-located worker, and facility worker) whether the resulting consequence would be above threshold values (AT) or below threshold values (BT).

3.3.2.4 Estimation of Accident Frequencies

The initiating event and sequence frequencies are based on a combination of predefined functional screening data and train-level hardware and human failure data found in *Design Guide: Integrated Safety Management* (24590-WTP-GPG-SANA-002). The data elements for the functional screening data are derived from past experience, with margins added to account for uncertainties introduced by their non-specificity. The data elements for the train-level hardware and human failure data are derived from simplified estimates of the failure probabilities and frequencies from typical events and train-level system configurations. The collection of data in 24590-WTP-GPG-SANA-002 serves as a guide for determining initiating event frequencies. When the initiating event is not readily discernable from 24590-WTP-GPG-SANA-002, expert opinion is applied to determine an applicable initiating event frequency.

The initiating event frequency reflects the frequency of a single event. The Risk Assessment performed for the WTP (section 3.8) groups functionally similar hazardous situations in its evaluation of overall facility risk to ensure the risks of potential higher frequency events are properly evaluated.

3.3.3 Identification of Potential Control Strategies

A control strategy selection process is applied to establish a set of controls that, in combination with each other, would provide the necessary and sufficient protection from the hazardous situation and its associated initiator. As part of the control strategy development, the ISM team identifies the safety functions needed to reduce the hazardous situation risk to within acceptable limits.

Controls chosen to accomplish the identified Safety Case Requirements (SCRs) are commensurate with the potential magnitude of the hazard. To accomplish a necessary and sufficient level of protection, the ISM team (consisting of work activity experts, hazard assessment experts, and hazard control experts as discussed in sections 3.3.1 and 3.3.2) selects a combination of controls that, when implemented, will meet the SRD exposure standards, risk goals, and defense-in-depth considerations. Specifically, these include the radiation exposure standards (RES) given in SRD Safety Criterion 2.0-1, the chemical exposure standards given in SRD Safety Criterion 2.0-2, the risk goals given in SRD Safety Criteria 1.0-3, through 1.0-5, and the defense-in-depth considerations of the general design given in SRD Safety Criterion 4.1-1.

The following elements are considerations in the selection of controls.

- Compliance with Applicable Laws and Regulations - If a strategy is mandated by law and would be effective in adequately controlling the hazard, selection of that control strategy is preferable to applying alternate controls.
- Introduction of Secondary Hazards - Controls are evaluated for their potential to introduce additional hazards to the process in their implementation. Controls with fewer secondary hazards are preferable.
- Priorities - Controls that prevent are preferred to controls that mitigate; controls that involve passive systems are preferred to controls that involve actively engineered systems; and controls that use engineered controls are preferred to controls that use administrative programs.
- ALARA - Controls that serve radiological as low as reasonably achievable (ALARA) goals are applied, where appropriate.
- Cost/Benefit Optimization - Controls that could address multiple accidents are selected to minimize implementation costs.
- Human Factors - Controls are selected based on human factors considerations.
- Operational Concerns - Controls that minimize the need for additional operators or maintenance personnel and minimize the impact to the normal process operation are selected.
- Reliability and Maintainability - Controls with higher reliability and ease of maintenance are preferred.

As discussed in section 3.3.2.3, each hazardous situation is assigned a severity level based on its unmitigated consequence in accordance with Table 3-1. SRD Appendix B establishes target frequencies for the preferred set of control strategies based on the severity level of the hazardous situation. Table 3-2 shows these target frequencies.

In meeting the target frequency, controls that incorporate diverse and independent SSCs to prevent the event are sought. After the preferred hazard control strategy has been identified, the event frequency - i.e., the product of the frequency of the initiating event and the probability that the control strategy will fail given the initiating event - is conservatively estimated. With the exception of facility workers, no credit is taken for administrative controls in calculating the event frequency. Verifying that the event frequency is less than the target frequency provides confirmation that the chosen control strategy includes sufficient SSCs to adequately implement defense in depth in a graded approach. The control selection also considers the need to satisfy the single failure criteria as identified in the implementing standard for defense in depth in the SRD.

For chemical hazards, controls are selected on the basis of the best industry practice and applicable local, state, or federal regulations regardless of the expected frequency of the event.

SSCs the ISM team determines are necessary 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 are included in the groups of SSCs defined as important-to-safety (ITS). However, the initial selection of those ITS SSCs required to meet the exposure standards may not be sufficient to comply with the risk goals. Therefore, during the ISM process, all SSCs that may prevent or mitigate a hazardous situation are recorded, not just those required to meet the exposure standards. The SSCs that provide defense-in-depth protection are recorded to ensure a complete picture of the control strategy is recorded.

3.3.4 Definition of Operating Environment

SIPD entries will include operating modes of involved systems, the aspects of the physical configuration of the system and its environment, and operating parameters that form the inputs to the initial or bounding conditions to the accident analysis. This information is generated as part of the accident analysis development. Environmental conditions to which ITS equipment may be subjected during the course of the accident are quantified. Specification of operating environment parameters beyond normal design parameters is established on a case by case basis, based on the characteristics of the accident. If the accident analysis results in high temperatures, for example, the analysis will address this aspect and specify the maximum temperature for which the SSC must be able to function.

3.3.5 Consideration of Common Cause and Common Mode Failures

Based on the experience of the hazards assessment experts and ISM team examination, considerations for natural phenomena events, external man-made events, loss of electrical power, fire, internal missiles from pressurized components and rotating equipment, and human error are included in the hazard evaluation as common-cause events. The natural phenomena hazard events considered include: earthquake, straight winds, wind missile, volcanic ash, storm-induced flooding, snow loading and range fires. The human-caused external events include hazards from accidents at nearby facilities; hazards from transportation accidents on nearby roads, railways and waterways; and the hazards of an aircraft crash. The importance of common cause failures increases as the reliability of individual systems increases, because they introduce effects that appear as dependencies between what would otherwise be independent failure events. This implies that without consideration of the potential for inter-event dependency, the validity of the control strategy selection process may be jeopardized.

Three broad categories of dependencies are used to classify and define the common cause failures that are expected to be important to the WTP project. Each represents a functionally different way in which commonalties between redundant systems, trains, or components can potentially reduce their overall expected reliability and are defined as follows:

- Functional dependencies
- Spatial dependencies
- Institutional dependencies

Each type of inter-component dependency or common cause failure mechanism is discussed as follows.

<u>Functional Dependencies</u>

Functional dependencies are the most common and generally the easiest to find and to understand. These dependencies reflect the reliance of multiple systems, trains, or components on a single system, train, component, or process condition. These dependencies typically result from:

- Process upsets that present simultaneous challenges to redundant systems, trains, or components
- Failure of individual components that provide multiple functions
- Failure of individual components that are shared by otherwise independent trains or systems
- Failure of common support systems that provide motive power, cooling, control, and actuation of process and safety components throughout the facility

- Common cause system failures which result from operator error

Defense against common cause failures resulting from shared components or components with multiple functions comes primarily from their overt recognition during the design phase, an assessment of their explicit contribution to process failures, and their effects on safety prior to their acceptance.

Defense against functional dependencies originating with the support system infrastructure usually comes from rigorous separation, i.e., from the division of support systems into two or more independent trains and careful maintenance of this physical and functional separation of systems, trains, and components throughout the facility. For example, an "A" train component would be powered from an "A" Bus, cooled with the "A" loop of the cooling system (which in turn would be powered from the "A" bus), and actuated from the "A" instrument channel. "B" components would be supported in a similar way from the "B" buses, loops, and channels.

System separation does carry a penalty in terms of a reduction in operational flexibility and potentially higher costs that result from the need for additional components in order to maintain the availability of these loops and trains while preventive maintenance is being performed.

Defense against operator induced common cause failures comes from good human factors engineering and an awareness and optimization of the more important influences on human reliability. This leads to an optimized man-machine interface and provides an operating environment that minimizes the chance of the operators being placed in an error prone situation where they may take inappropriate actions that have a near-simultaneous impact on more than one independent process system, train, or component.

Spatial Dependencies

Spatial dependencies between otherwise independent pieces of equipment originate with their relative locations and the potential for physical interactions or common loss. Examples include, the near simultaneous failure of two components as a result of their collocation in an area that experiences the effects of:

- Internal fires or explosions
- Internal floods from failed tanks, cooling systems, etc.
- Externally applied forces and loads from seismic activity, airplane crashes, vehicle crashes, etc.
- 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 physical separation to minimize the likelihood of multiple failures from a single casualty.

Examples of commonly used techniques to minimize the propagation of failures or the susceptibility of systems to the effects of these hazards are as follows:

- Physical isolation, separation, and protection using structural features of the facility (secured rooms to limit the effects of floods, fires, and single point external threats)
- Fire barriers and fire suppression systems (fire protection and preventing propagation from area to area)

- Isolated drain and vent systems (flooding protection and preventing propagation from area to area)
- Seismic design and qualification (earthquake protection)
- Robust design of the facility structure (protection from severe weather and external threats)

Institutional Dependencies

Institutional dependencies come from activities within the plant by maintainers, operators, designers, and equipment procurers that result in the near-simultaneous failure of otherwise independent components. These may also be called common mode failures since their effect is often manifest as a set of components failing in the same way at approximately the same time. Examples of the causes for failures of this type include:

- Use of identical components with the same maintenance and operating cycle that contributes to near simultaneous wear-out
- Use of identical components that lead to the appearance of coincident failures resulting from inherent design weaknesses or from the misapplication of hardware (improper service factor)
- Labeling, training, 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
- Using a single maintenance crew to maintain/adjust/calibrate independent equipment during the same time period (a mistake/error during the maintenance or restoration of one piece of equipment is repeated on a second, similar piece of equipment so that the probability of near simultaneous failure is increased)

Defenses against institutional common cause failures include the use of functionally diverse equipment, staggered maintenance for independent channels/trains of equipment, post maintenance and testing requirements, configuration management controls, and personnel training and awareness.

3.3.6 Documentation

The proceedings and results of the ISM team meetings are recorded in meeting minutes. The selected control strategies, the safety related functional requirements, the SSCs which will meet the functional requirements, and references to documents describing the control strategy selection are entered into the SIPD.

The hazard evaluation results for the PSAR are based on SIPD information at the time of the PSAR submittal. Those results are documented in the facility-specific PSAR volumes in an appendix that summarizes the hazard evaluation ISM results. The definitions of the information presented in the respective fields of the summary appendix are as follows:

Field Name	Definition
Hazardous Situation ID	A unique identification number for a given control strategy development (CSD) associated with a hazardous situation. The format for this identification number is: CSD-[FACILITY][SYSTEM]/[DATABASE ISM RECORD NUMBER]. For example, record CSD-LRLD/0011, C3/C5 drain vessel V25002 pump/valve spray leak, is a sequential number indicating the facility ("L", for LAW vitrification facility), system ("RLD", for Radioactive Liquid Waste Disposal System), and a unique number to identify the record.
Initiator	A description of the initiating event(s) which could lead to the hazardous situation. For example, control system fault causes container handling area crane A to drive into maintenance area B with shield door C not open, resulting in dropped container.
Accident Type	A classification of accident type or dispersal mechanism. For example, "spray leak" for a pin hole leak in pressurized piping.
Initiating event frequency (Init. Freq.)	The frequency (per year) of the initiator-that is, the frequency that the hazardous situation would occur, given standard industrial design practices For example, the initiating event frequency for overflows reflects the reliability of level controls in the distributed control system (DCS), but would not account for additional elements of the control strategy such as automated trips.
Hazardous situation	A description of the actual hazard (such as, hazardous material and the mechanism by which harm is caused) For example, release of High Level Waste (HLW) glass product from dropped canister causing radioactive material inhalation hazard in operating area A adjacent to container handling area B.

The severity level of the unmitigated consequences associated with the CSD is listed for each of the three target groups: facility worker, co-located worker, and public. The definition and location of these receptors is defined as follows:

Facility Worker	An individual within the controlled area of the facility performing work for or in conjunction with the Contractor or utilizing Contractor facilities. Facility workers includes individuals within the WTP Controlled Area Boundary, including the Tank AP-106 area.
Co-located Worker	An individual within the Hanford Site beyond the Contractor-controlled area, performing work for or in conjunction with DOE or utilizing other Hanford Site facilities. Co-located workers include individuals at the most limiting location at or beyond the WTP Controlled Area Boundary.
Public	Individuals who are not occupationally engaged at the Hanford Site. Public includes individuals at the most limiting location outside the Contractor-controlled area along the near Columbia river bank/Washington state highway 240/the southern boundary of the Hanford reservation. For groups who are not affected by the hazard, N/A is entered in this field.

Field Name	Definition
Control Strategy Element	Identification of the systems/actions required to prevent or mitigate the hazardous situation.
Safety Case Requirement/ Design Assumption	This field contains three sets of information identified below: • SCR number - A unique number identifies safety case requirements. The format of that identification number is SCR- [PLANT][FUNCTION]/ [DATABASE RECORD NUMBER]. • Safety case requirements - Safety functions to which the design and operation of the plant must comply in order for the safety case associated with the given hazardous situation to be valid. These include design assumptions related to the set of control strategies. • Control attributes - Attributes associated with a given hazardous situation summarizing the type of control such as active or passive, the control measure such as, preventative or mitigative, and the control Important to-Safety classification such as safety design class (SDC), safety design significant (SDS), or other such as not SDC or SDS but, provides a Defense-In-Depth safety function. Administrative controls credited in the hazard analysis, for example, programmatic or procedural requirements with a safety function, were also classified as 'other'.

3.3.7 Definition of Design Basis Events

For each facility volume, a set of representative internal DBEs grouped by similar control strategies, release mechanisms, and consequences is selected from the full range of potential accidents identified through the ISM process. The set of representative DBEs portray the bounding events for the facility in question, and undergo a more detailed analysis (refer to section 3.4) to establish the basis for the performance requirements identified in the hazard evaluation and to confirm adequate facility safety. Natural phenomena events and man-made external event DBEs are analyzed on a case-by-case basis, as well.

The specific results of the DBE selections are addressed in the facility-specific volumes of the PSAR. The general methodology of DBE selection for each facility follows.

3.3.7.1 Radiological DBEs

To begin identification of DBEs for radiological hazards, the events recorded in the SIPD for a facility are pre-sorted to extract events with SL-1 or SL-2 consequences to either the co-located worker or to the public. This set of records is then subjected to the DBE selection process. This emphasizes the more hazardous events. Hazardous situations with unmitigated initiator frequencies beyond the extremely unlikely range (frequency $<10^{-6}$ per year) are not included in the DBE selection process. The data values used to estimate the key event frequencies are deliberately conservative, so screening of extremely low frequency sequences can be made with a high degree of confidence.

The events screened in the pre-sort comprise a subset of events which either affect only the facility worker, or affect both the facility worker and the co-located worker or the public with SL-3 or lower consequences to the population groups. The facility worker DBE selection process is handled separately, as discussed later in this section.

The extracted credible (> 10^{-6} events/yr) hazardous situations (SL-1, SL-2) are sorted into subsets, consisting of the hazardous situations that have common accident types and rely upon common elements in the makeup of their control strategies. This focus on control elements and accident types helps ensure the resulting set of DBEs explicitly consider the functions that must be delivered by the controls, and the DBEs are representative of the conditions that drive the performance requirements for those controls. These results may be further sorted into common system groups (for example, piping or vessel groups) to better accommodate tailoring of the design standards. Because every hazardous situation applies a control strategy, each individual hazardous situation is addressed. Because some hazardous situations rely upon several controls, this methodology leads to the same hazardous situations being considered several times in the context of different control elements.

The set of hazardous situations in each functional control requirement subset is further divided into groups according to accident type or dispersal mechanism. The objective is to comprehensively define and bound all challenges to the ITS SSCs. The types of accident groups identified for the WTP include the following:

- Liquid spills (overflows, vessel failure, piping failure)
- Drops of radioactive material
- Pressurized releases
- Chemical reactions
- Boiling
- Offgas releases
- Seismic
- Fires
- Molten glass spills
- Explosions
- Spray leaks
- Loss of contamination control
- Steam release
- Criticality
- Direct radiation
- Additional categories as necessary for those events not represented by existing groups

Finally, each group is further sorted into two groups based on severity level designation. Events having SL-1 consequences to the co-located worker are placed into one group, and events with SL-2 consequences to the co-located worker are placed into the second group. In all cases the SL for a hazard to a co-located worker will be equal to or greater than the SL for that same hazard to the public. Therefore, the performance and design requirements for the control strategies are driven by the co-located worker. This sorting is performed because control strategies may differ between SL-1 and SL-2 events.

One or more DBEs are selected as representative of each of the groups. Each grouping contains a collection of events with a common accident type, control requirement, and severity level to the co-located receptor. Within each group, each event is considered with respect to every other event in the group. Based on this comparison, engineering judgement is used to select the event which bounds all others in the group to represent the DBE selected for further analysis. The basis of the DBE selection scheme is to ensure every event in a group is considered and that every event is represented and bounded by a DBE.

To establish facility worker radiological DBEs, the hazardous situations in the SIPD are sorted to extract all events with SL-1 or SL-2 consequences to the facility worker, excluding those with both identical control strategies and identical accident types as the co-located worker and public SL-1 and SL-2 events. These will be evaluated later as described below. These remaining events are sorted by accident type and severity level to form groups similar to the co-located worker and public DBE process. Hazardous situations involving the facility worker that are of the same accident type and have similar consequences and controls are grouped and evaluated in further detail. The final DBE selection relies on a qualitative evaluation of the initiators, hazardous situations, and consequences.

3.3.7.2 Chemical DBEs

For chemical hazards, chemical events with above threshold consequences to the co-located worker or public as described in section 3.3.2.3, are listed as unique DBEs. Performance requirements are specified on a per-event-basis for these hazardous situations.

To establish facility worker chemical DBEs, the hazardous situations in the SIPD are sorted to extract all events with consequences to the facility worker that are above threshold, excluding those with both identical control strategies and accident types as the DBEs already established for the co-located worker and public. These events are evaluated in further detail. The final DBE selection relies on a qualitative evaluation of the initiators, hazardous situations, and consequences.

3.3.7.3 Repopulating Remaining Hazardous Situations

Once the DBE selection and analysis have been completed for the public, co-located worker, and facility worker, the results of the DBEs are qualitatively evaluated against the complete set of SL-3 and above SIPD hazardous situations to ensure the control strategies bound all hazardous situations for the public, the co-located worker, and the facility worker. This comparison is made against both the events grouped with DBEs as part of the DBE selection process, and those events that were previously screened. The goal is to define a representative DBE for each hazardous situation of SL-3 or higher consequence. SL-4 events meet the RES by definition, and chemical hazards that exceed their exposure standards have already been addressed on a per-event-basis.

Where the hazardous situation is bounded by a DBE and its control strategy, the SIPD is updated to record the DBE which bounds the SIPD entry. Any unique hazardous situations or hazardous situations whose preferred control elements do not fall within a single DBE control strategy are used to generate additional DBE scenarios. This process continues until a representative and the bounding DBE has been assigned to all SL-3 or higher SIPD entries with an initiating event frequency greater than 10^{-6} events/year.

3.3.8 Classification of Structures, Systems, and Components

The design classification process used on the WTP project provides a consistent, project-wide approach for the classification of the SSCs based on their importance to controlling normal releases and accident prevention and mitigation. This approach ensures that SSCs are designed, constructed, fabricated, installed, tested, operated, and maintained to quality standards commensurate with the importance of the functions that need to be performed. As the facility moves to deactivation, and the safety functions change, the classification of SSCs will be revised as necessary. The design classification system provides assurance to DOE that the defined safety functions of SSCs will perform as intended.

In this approach, SSCs are designated as Important-to-Safety in accordance with the definition of this term as provided in DOE/RL-96-0006, Revision 2, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.*

SSCs designated as Important-to-Safety for the RPP-WTP include the Safety Design Class, Safety Design Significant, and Risk Reduction Class, as defined in SRD SC 1.0-8. These SSCs are defined as follows.

1) SSCs needed to prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards 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.
3) SSCs that are Important-to-Safety that are neither SDC or SDS are designated as Risk Reduction Class.

<u>**Safety Design Class (SDC)**</u> - Applies to those 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 is designated as SDC.

SDC SSCs typically are identified by the results of accident analyses that show the potential for exposure standards to be exceeded or to prevent a criticality. However, additional items may also be designated SDC independent of a specific accident analysis. These are items that protect the facility worker from potentially serious events. Typically, these events are deemed to present a challenge to the facility worker severe enough that mitigation is prudent, without the need to perform a specific consequence analysis.

When a SSC is designated as Safety Design Class it has the following attributes:

1) Engineering procedures describe the requirements associated with designation of Quality Level requirements.
2) For an active system or component, the safety function is preserved by application of defense-in-depth such that failure of the system or component will not result in exceeding a public or worker accident exposure standard. For a mitigating feature, this means that, given that the accident

has occurred, the consequence of the accident will not result in exceeding a public or worker exposure standard. For a preventative feature, this means that the failure of the system or component will not allow the accident to occur and progress such that a public or worker accident exposure standard is exceeded. This requirement may be achieved by designing the Safety Design Class system or component to withstand a single active failure or by designating two separate and independent systems or components as Safety Design Class.

3) The SSC is designed to withstand the effects of natural phenomena such that it can perform any safety functions required as a result of a natural phenomena event. For example, if an earthquake can produce exposures to the public or workers in excess of standards, the Safety Design Class SSC that prevents or mitigates the exposures would be designed to be DBE-resistant and designated as Seismic Category I for radiological hazards (or Seismic Category III for chemical hazards). However, DBE-resistance is not applied automatically to Safety Design Class SSCs. It is applied only when the earthquake is the initiating event, or when the earthquake could cause the initiating event. A Safety Design Class SSC that does not have a DBE mitigating function is designated as Seismic Category III.

   This natural phenomenon hazard (NPH) design philosophy is used for all severe natural phenomena events (i.e., earthquake, flood, high wind). Therefore, if a Safety Design Class SSC is needed for meeting public or worker exposure standards for a given NPH event, the NPH loads associated with that event are taken from SRD Volume II, Table 4-1, "Natural Phenomena Design Loads for Important-to-Safety SSCs with NPH Safety Functions". All other NPH loads for the Safety Design Class SSC may be taken from SRD Volume II, Table 4-2, "Natural Phenomena Design Loads for SSCs without NPH Safety Functions" in lieu of SRD Table 4-1.

4) General and specific design requirements are applied as identified in Section 4.0 of the SRD for Safety Design Class SSCs.

5) Other design requirements may be applied based on the specific safety function to be performed by the Safety Design Class SSC. This specific safety function is determined from the accident analysis that identified the need for prevention or mitigation by Safety Design Class SSCs.

6) Operational requirements (e.g., periodic testing and preventative maintenance) are applied to Safety Design Class SSCs through the application of Technical Safety Requirements (discussed in PSAR Volume I, Section 17.4.5)

Safety Design Significant (SDS) - Applies to those SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; SSCs whose failure would directly prevent Safety Design Class SSCs from performing their safety function; and SSCs that are required to meet SRD Appendix B, section 3.0, Table 1, "Implementation of Defense in Depth by SSCs."

When a SSC is classified as Safety Design Significant it has the following attributes.

1) Engineering procedures describe the requirements associated with designation of Quality Level requirements.

2) The SSC is designed to withstand the effects of natural phenomena such that it can perform its safety functions required as a result of a natural phenomena event. If an earthquake can produce exposures to the public or workers in excess of standards, the Safety Design Class SSC that prevents or mitigates the exposures would be designed DBE-resistant as discussed above. The same NPH loads also are applied to a Safety Design Significant SSC if failure of the item could prevent the Safety Design Class SSC from performing its safety function required as a result of the DBE. Such an SSC is designated Seismic Category II. It should be noted, however, that DBE resistance is not automatically applied to Safety Design Significant SSCs. It is applied only when the earthquake is the initiating event, or when the earthquake could cause the initiating event. A Safety Design Significant SSC that does not have a DBE mitigating function is designated Seismic Category III.

   This NPH design philosophy is used for all severe natural phenomena events (i.e., earthquake, flood, high wind). Therefore, if a Safety Design Significant SSC is needed to meet public or worker exposure standards for a given NPH event, the NPH loads associated with that event are taken from SRD Volume II, Table 4-1, "Natural Phenomena Design Loads for Important-to-Safety SSCs with NPH Safety Functions". All other NPH loads for the Safety Design Significant SSC may be taken from SRD Volume II, Table 4-2, "Natural Phenomena Design Loads for SSCs without NPH Safety Functions" in lieu of SRD Table 4-1.

3) General and specific design requirements are applied as identified in Section 4.0 of the SRD for Safety Design Significant SSCs.
4) Other design requirements may be applied based on the specific safety function to be performed by the Safety Design Significant SSCs.

__**Risk Reduction Class (RRC)**__ - Applies to Important to Safety SSCs that are neither SDC nor SDS.

When an SSC is classified as Risk Reduction Class (RRC), it has the following attributes:

1) Quality requirements for RRC items shall be in accordance with the QAM and DOE Order 414.1A.
2) An SSC, not designated as SDC or SDS, whose function is necessary to ensure the integrity of the boundaries retaining radioactive materials is classified as RRC when the SSC contains a significant quantity of radioactivity, as illustrated by Table 1-3.
3) An SSC, not designated as SDC or SDS, whose function is necessary to ensure the capability to place and maintain the facility in a safe state is classified as RRC. In this context, a facility is considered to be in a safe state when:
   - The facility process has been rendered safe and no pressurized material flow occurs in the process lines (i.e., process transfers involving significant quantities of radioactive or extremely hazardous materials have stopped and the material is contained in passive SSCs).
   - Any active, energy generating, process reactions are in controlled or passive equipment (i.e., process reactions that generate energy, e.g., heat or pressure, or flammable gasses are contained or controlled such that these byproducts do not pose a significant hazard).
   - The structures, systems, and components necessary to reach and maintain this condition are functioning in a stable manner, with all process parameters within normal (i.e., predetermined) safe state ranges.
4) Design codes and standards for RRC SSCs will be selected in accordance with the process defined in SRD Volume II, Appendix A and will be (at a minimum) consistent with practices in the commercial radiological or chemical industries, as appropriate.

5) RRC SSCs will be included in the maintenance, testing and operations programs to ensure their availability when needed. The configuration of RRC SSCs will be managed as part of the technical baseline, including replacement parts evaluation, setpoint control, and design change control

The processes for identifying the SSCs for each of the groups of SSCs Important-to-Safety and the requirements assigned to each of the groups are discussed in Appendix A of the SRD Volume II.

RRC SSCs include those that are identified as significant contributors to safety by the analyses that confirm the facility accident risk goals are met (this is one way to identify SSCs that place frequent demands on, or adversely affect the function of, safety design class SSCs if they fail or malfunction).

As part of the ISM process, SSCs identified in the SIPD are categorized as being SDC, SDS, or RRC.

3.3.9 Identification of Standards

Identification of standards is an iterative activity. Initially, the set of standards and requirements is derived from a general understanding of the hazards inherent in the work. As the design evolves, the hazard evaluation and the development of the control strategies justify tailoring the set of standards to better fit the hazards.

As part of the ISM process, the ISM team identifies a tailored set of standards and requirements that ensure adequate safety when implemented. The identification of design, fabrication, and construction standards is performed by an integrated team including work activity experts (discussed in section 3.3.1), hazard assessment experts (discussed in section 3.3.2), hazard control experts (discussed in section 3.3.3), and standards experts. The standards experts are drawn from the Engineering department and the Environmental Safety and Health (ES&H) department.

The standards identified are evaluated and tailored for each control strategy identified in the SIPD based on compliance with applicable laws and regulations, conformance with the DOE-stipulated top level standards, and output of the preceding hazard evaluation and control strategy development steps. SRD Appendix A describes the typical considerations in the standards identification activity.

Documentation of the standards and requirements identification process provides justification of the set selected and links each control strategy to its associated set of standards. The information generated during standards selection is confirmed following detailed accident analysis, and retained in the SIPD for each control strategy. Chapter 4.0 discusses the standards confirmation process in more detail.

3.4 Accident Analysis Methodology

This section presents the methodology for formal development and analysis of the potential accidents at the WTP facilities. Results of the accident analyses are provided in the facility-specific volumes.

The accident analysis for each DBE starts with a description of the accident scenario with the major assumptions identified. The accident source term is then determined. Source terms for the accidents are based on the quantity and composition of the hazardous material at risk for release, postulated release mechanisms, and considerations of leak path factors. Once a source term has been determined, the preferred control strategy for the DBE is then applied. Mitigated consequences are then calculated, if applicable (i.e., if the control strategy involved mitigative elements and is not limited to purely preventive measures). The potential for failure (failure frequency) of the control strategy elements is assessed for radiological events. Together, these elements (mitigated consequences and failure probabilities for those events with radiological consequences) are compared to the exposure standards and the defense in depth considerations in the SRD to confirm the adequacy of the preferred control strategy.

3.4.1 Scenario Development

Assessment of the potential radiological consequences of DBEs depends on assumptions adopted for the analysis concerning the progression of events beginning with the initiating event and ending with the duration of receptor exposure. Event scenarios are described at a level of detail appropriate to the PSAR stage of development, based on current design information and available operating details. As design modifications and operational details progress, scenarios may be refined to better describe the physical conditions specific to the hazardous situation.

The accident involves an initiating event that could lead to a release from the primary confinement barrier. The initiating event frequency and consequence of an accident sequence associated with the DBE are calculated without taking credit for design features or facility controls that would prevent the accident or lower its consequence. The preferred control strategy elements identified in the hazard evaluation process are then applied to reduce the consequence and frequency of the accident to acceptable levels according to the radiological and chemical exposure limits defined in SRD Safety Criteria 2.0-1 and 2.0-2.

Event trees, depicting the trajectory for each accident sequence which involves the range of initiating events and possible operating states for each of the selected Hazard Control Strategies, were developed as part of the overall risk assessment and quantified to better understand many of the DBEs. The event trees were constructed in EXCEL, and quantified with appropriate initiating event frequencies and conditional branch-point probabilities. Initiating event frequencies and conditional failure probabilities needed to fully quantify the event trees, developed in EXCEL, are as follows:

- If the initiating event results from failure of a single SSC, the initiating event frequency is calculated directly from the failure rate information provided in the WTP reliability data base.
- If the conditional failure probability for a particular event results from failure of a limited set of individual SSCs, the failure probabilities are calculated directly from the failure rate information provided in the WTP reliability data base.
- If the initiating or embedded event tree failures result from failure of a system, the required failure frequencies and probabilities are calculated from system failure models. These models are developed as a fault trees to reflect specific system success criteria, quantified from information provided in the WTP reliability data base and solved with the WinNUPRA systems analysis code.

The scenario description includes the operating modes of involved systems, the aspects of the physical configuration of the system and its environment, and operating parameters that are initial or bounding conditions to the accident analysis. Environmental conditions to which ITS equipment may be subjected during the course of the accident are quantified as well. The scenario development presentation includes a discussion of assumptions inherent in the scenario with an assessment of the conservatism and uncertainty incorporated by these assumptions. Key assumptions which, if altered or modified, could have a significant detrimental impact on the analysis results, may require protection by technical safety requirement (TSR) control as identified in the summary of ITS SSCs and TSR controls.

3.4.2 Source Term Analysis

Assessing the source term of a hazardous material release involves considering the quantity and composition of the hazardous material at risk (MAR) for release. The MAR is the total quantity of hazardous material available to be acted upon by the physical stresses produced during a particular accident scenario. For radiological hazards, the MAR is expressed in terms of grams, liters, or curies of activity for each radionuclide. For chemical hazards, the source term is expressed in terms of a release rate for the substance in question. For a particular DBE, the material at risk is a conservative value representing some maximum quantity of hazardous material present or reasonably anticipated to be present for the process or structure being analyzed.

3.4.2.1 Radiological Source Terms

The radiological MAR for release from WTP facilities consist of the process streams, liquid effluent streams, offgas streams, stored intermediate and final products, and accumulation points (for example, ion exchange columns or filters). Process engineering provides process stream information used for assessing radiological consequences of accidents. The provided information includes the expected ranges and upper bounds of radionuclide inventory for the various facility areas, and relevant physical and chemical properties of streams and storage forms. The MAR for release is developed for these areas based on:

- Contract values for determining bounding feed concentrations received by the WTP Project
- Maximum concentrations (i.e., the upper end of the range of expected compositions) in the feed streams to the HLW and LAW processes
- Concentrations downstream of components designed to remove radioactive material from the stream having the minimum anticipated efficiency of the removal component
- Maximum operating capacities
- Minimum dilution process changes and maximum concentration process changes based on operating ranges of the dilution or concentration process

The MAR may be increased by scenario considerations as well, such as process upsets.

As a result of forces produced during an accident, a portion of the MAR becomes available for transport through the air. Material will mix with airflows if it is a gas or if environmental conditions produced by the accident creates a gas. Solid or liquid materials may fracture into small particles or droplets that can remain airborne. Subsequent to MAR identification, these factors that determine the fraction of the MAR made airborne are considered. The factors are a function of the physical forces that cause the release, and the physical and chemical characteristics of the MAR.

The WTP accident analysis uses data based on experimental results, or physical models, to characterize the quantity of material that becomes and remains airborne, and is available for transport from confinement. The following data sources are used as appropriate for assessing airborne release quantities. In cases where the accident phenomena adequately correspond to models described by these sources, these sources are given priority over other material for deriving source terms.

- DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE 1994)
- NUREG/CR-6410, *Nuclear Fuel Cycle Accident Analysis Handbook* (NRC 1998)

Finally, the source term assessment considers the factors that determine the fraction of the airborne material that leaves the confinement barrier. These factors, termed leak path factors, consider the effects of physical mechanisms such as depletion by physical processes (e.g., coagulation and sedimentation), holdup by passive structures (e.g., deposition), and (for mitigated calculations) removal by active systems (e.g., filters) in the path to the receptor. The leak path factor is the fraction of airborne material that exits an enclosure (cell or building) while remaining airborne. The LPF is normally a function of time as the accident progresses. However, in some cases an overall (time-independent) leak path factor is used to represent the fraction of the total respirable material suspended during the accident that leaves the enclosure. The specific value of each parameter contributing to the source term is determined in the individual DBE analyses based on the physical phenomena of the accident.

3.4.2.2 Chemical Source Terms

For chemical hazards, the source term is expressed in terms of a release rate for the substance in question. The release rate defined by the scenario is based on the methods for worst-case scenarios given in the US Environmental Protection Agency (EPA) *Risk Management Program Guidance for Offsite Consequence Analysis* (EPA 1999).

3.4.3 Consequence Analysis

3.4.3.1 Radiological Consequence Analysis

Exposure of receptors at a distance from the facility takes account of decreasing air concentrations from the spreading contaminant plume during its travel downwind. Atmospheric dispersion coefficients (χ/Q values) provide an estimate of air concentration of a contaminant at a given distance away from a release. The elevation of a release affects the χ/Q value. For mitigated scenarios, the release is assumed to be elevated (that is, the exhaust stack) if that assumption is appropriate to the scenario.

The χ/Q values are calculated consistent with the methodology recommended in Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants* (NRC 1982). Regulatory Guide 1.145 recommends that, when site specific meteorology data are used for calculating dispersion coefficients, both the 99.5 % sector specific and the 95 % overall site χ/Q be calculated for each location of interest. The more limiting value of the two is then used in calculating the consequence estimates. The limiting value for the WTP was found to be the 99.5 % sector specific value. The joint frequency data used for the calculations were from the Hanford Meteorology Station, 9 year (1983 through 1991) averaged data published in Hanford Environmental Dose Overview Panel's *Recommended Environmental Dose Calculation Methods and Hanford-Specific Parameters* Appendix H.3 (Schreckhise, et al., 1993).

A computer model, GXQ (Hey 1994) that incorporates the methodology of Regulatory Guide 1.145 and Hanford Site meteorology data is used for the calculations. The method assumes contaminants disperse in air from the site of a release as a plume and the distribution of contaminant concentration in the plume is Gaussian. All dispersion calculations crediting plume meander used the Regulatory Guide 1.145 plume meander model incorporated in GXQ. The calculations crediting building wake used the Regulatory Guide 1.145 building wake model incorporated in GXQ.

Three population groups, public, co-located worker, and facility worker, have consequences assessed from postulated off-normal and accident events at the WTP. For each population group, the consequences to an individual at a limiting location (for example where resulting consequences are highest) are assessed.

A public receptor is defined as an individual at a boundary established around the facility at the nearest locations of uncontrolled public access. The boundary for the WTP is encompassed by the Columbia River to the north and east, and Highway 240 to the west. The southern boundary extends in an east-west line from the near bank of the Columbia River, across the northernmost part of the Energy Northwest site boundary, and intersects the Wye Barricade. From the Wye Barricade, the southern boundary extends at a 225° angle from north until it intersects with Highway 240. SRD Appendix D shows the boundary. Exposure time to the public receptor is assumed to be a maximum of 24 hours for most WTP events. This maximum duration is judged to be an appropriate endpoint for consequence calculations based on the premise that the public receptor can be notified and appropriate corrective action taken within 24 hours of the start of the accident.

The location of the limiting public receptor is found by calculating the atmospheric dispersion coefficient (χ/Q) in each sector at the "…minimum distance from the stack or, in the case of releases through vents or building penetrations, the nearest point on the building to the boundary within a 45-degree sector centered on the compass direction of interest." (NRC 1982) *Design Guide: Radiological Consequence Analysis* (24590-WTP-GPG-SANA-004) gives the distances to the nearest receptor for each of 16 directional sectors. A 99.5 % ground level χ/Q was calculated using Hanford Site specific meteorology data. Based on the results as shown in 24590-WTP-GPG-SANA-004, the limiting public receptor is found to be at a distance of 10.5 km in the eastern sector.

The location of the co-located worker is defined as an individual outside the WTP controlled area boundary but within the boundary established for potential public occupation. For ground level releases, the co-located worker is assumed to be 100 m from the release point. There are locations west and north of the WTP controlled area within 100 m of the HLW and pretreatment (PT) buildings. Using a 100 m distance to calculate this co-located worker dose slightly under estimates the dose received for co-located workers located outside of the controlled area and within 100 m of the HLW and PT buildings and is potentially non-conservative. Even though it is anticipated that the mitigated dose to such individuals will be well below the radiological exposure standards (RES), Bechtel National, Inc. (BNI) will establish administrative controls to ensure individuals outside the controlled area fence and within 100 m of the HLW and PT buildings will be evacuated in a timely manner in the event of an accident at HLW or PT, thereby reducing their exposure even further. For elevated releases the limiting co-located worker location is the one between 100 m and the public boundary that gives the highest χ/Q. The maximum exposure time for co-located workers is 8 hours, based on the assumption that the worker will be in place for the length of one 8-hour shift at most.

The facility worker is generally assumed to be located as near the location of the event as is reasonable in the context of the development of the accident. If the event occurs inside a process cell or cave where personnel are excluded during the operating mode in effect at the initiation of the event, the facility worker is assumed to be located in the potentially occupied area outside the cell nearest to where the release or unshielded radiation could leave the cell. The assumed exposure time for the facility worker is dependent on the specific event scenario.

Exposure to radiation external to the body can occur a number of ways. All are potential contributors to total dose to a receptor resulting from an accident. They include the following:

- Radiation received by inhalation of contaminated air passing through the receptor's location. This contributor is the primary pathway for radiological exposure to the co-located worker and the public, and is also an important exposure pathway for the facility worker.
- Radiation shine when there is a direct, unshielded path between the source and the receptor. This contributor is of interest primarily to the facility worker. The distance to the co-located worker and public receptor makes this contributor insignificant for determining consequences to the co-located worker and the public.
- Radiation scattered by particles in the air and deflected to the receptor's location when the source is unshielded from above (skyshine). This contributor is of interest to the co-located worker when indicated by the scenario. The distance to the public receptor makes this contributor insignificant for determining consequences to the public.
- Radiation received from submersion in a cloud or plume of contaminated air passing through the receptor's location. ^{137}Cs is the dominant contributor to submersion doses from material present in the WTP. Even if a receptor were exposed to respirable solids containing ^{137}Cs as the only radionuclide, the submersion dose would represent only about 1 % of the total dose. Therefore, the air submersion dose is not significant compared to the inhalation dose for releases from the WTP.
- Radiation received from submersion in contaminated water. No bodies of water within the WTP established public boundary are used for recreational purposes. Incident recovery plans would prevent significant exposure from contaminated bodies of water beyond the WTP established public boundaries. Therefore, no contribution from water submersion is included in estimating potential doses from releases from the WTP.
- Radiation from radionuclides deposited on the ground during travel of the contaminated cloud downwind (ingestion). Exposure by the ingestion pathway occurs through consumption of drinking water or foodstuffs onto which radionuclides have been deposited. Radionuclides may also enter the food supply through uptake from soil and water into vegetable products, and ingestion of contaminated materials by food producing animals. The US Department of Energy (DOE) controls the area immediately adjacent to the WTP and no farming occurs there. In the case of contamination deposited beyond the Hanford Site boundary, significant uptake into the food and water supply would be slow. Incident recovery plans would interdict and prevent consumption of agricultural products from contaminated areas. Therefore, no contribution from ingestion is included in estimating potential doses from releases from the WTP.

The exposure by internal pathways is normalized as a 50-year committed effective dose equivalent (CEDE) based on the biological deposition locations and residence times of the radionuclides. EPA-520, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988) gives inhalation dose conversion factors (50-yr CEDE per unit intake) for various radionuclides.

3.4.3.2 Chemical Consequence Analysis

For the co-located worker and the public receptors, the release rate for the substance in question is used to calculate a toxic endpoint for the substance in question. For the WTP, the toxic endpoint is taken to be the ERPG-3 (or TEEL-3) for the co-located worker and the ERPG-2 (or TEEL-2) for the public receptor, per SRD Safety Criterion 2.0-2. To determine the predicted distances to the toxic endpoint for both receptors, the appropriate table in Appendix B of EPA 1999 is consulted based on the following criteria.

- Exhibit B-1 and B-2 in Appendix B of EPA 1999 are used to determine whether the substance should be treated as a neutrally buoyant plume or a dense gas.
- Rural conditions apply for the Hanford Site.
- The 10-minute table is used for toxic chemicals that are gaseous at typical ambient temperatures and for evaporation from pools of common water solutions. For evaporation from a toxic liquid pool, if the duration of evaporation is 10 minutes or less, the 10-minute table is used. If the duration of evaporation is more than 10 minutes, the 60-minute table is used.

For facility workers, concentrations of a released chemical in the worker's breathing space are affected by whether the release occurs inside or outside unoccupied process cells or caves. If the release occurs inside the unoccupied process cell or cave, the worker is exposed after the airborne material mixes with the cell air and leaks through cave penetrations to the worker's location outside the cell.

3.4.4 Comparison with Exposure Standards

3.4.4.1 Radiological Exposure Standards

The mitigated DBE, where controls have been applied that reduce the consequence or frequency of the accident, are compared to the RES defined in SRD Criterion 2.0-1 to demonstrate the adequacy of the controls identified by the ISM team to meet the RES.

3.4.4.2 Chemical Exposure Standards

Using the predicted distances to the toxic endpoint for both the co-located worker and the public receptor, the values are compared to the distances of 100 m and the shortest distance to the site boundary, respectively. If the predicted distance for the co-located worker is greater than 100 m, then the co-located worker is exposed beyond the limits of the SRD standard (SRD Criterion 2.0-2). If the predicted distance to the public is greater than the shortest distance to the site boundary, the public exposure exceeds the standard.

For facility workers, the predicted concentration in the workers breathing space is compared to the published Immediately Dangerous to Life and Health (IDLH) values. If the calculated concentration exceeds the IDLH value, the facility worker exposure is considered to exceeds the SRD standard.

If exposures exceed SRD Criterion 2.0-2, controls designed to prevent or mitigate the accident are classified as SDC. If the control is mitigative, the analysis is repeated with the control in place to demonstrate that the predicted exposures from the mitigated scenario do not exceed the standard.

3.4.5 Defense in Depth

An evaluation of the number of layers of prevention and mitigation in relation to the significance of the hazard is conducted for the hazardous situations identified as part of the hazard analysis process, consistent with SRD Appendix B, (24590-WTP-SRD-ESH-01-001-02). This evaluation determines if defense in depth principles have been adequately met. The results of this evaluation are captured in the hazard evaluation results as part of the hazard analysis documentation and confirmed by the DBE analysis. Implementation of defense in depth requires that the single failure criterion, provision for physical barriers, and target event frequencies be applied in a tailored fashion. The following considerations are applied in the implementation of defense in depth. The SRD identifies that administrative controls alone may be credited as the controls that protect facility workers, when appropriate.

- Single failure criterion. Per the SRD requirements, single failure criterion in accordance with ANSI/ANS-58.9 for fluid systems and IEEE Std 379 for electrical and instrumentation and control systems are applied in a tailored fashion. For SL-1 events, the application of the single failure criterion is mandatory. For SL-2 events, the single failure criterion is considered by objective assessment. For SL-3 and SL-4 events, the single failure criterion is not required to be applied.
- Provision for physical barriers. Two or more independent physical barriers that provide confinement against the release of hazardous materials are required for SL-1 and SL-2 events. For SL-3 events, at least one physical barrier is provided, and two or more independent physical barriers are considered by objective assessment. For SL-4 events, physical design features, administrative controls, or both are provided per 10CFR 835.1001.
- Target event frequencies. The target event frequencies established by the SRD are presented in Table 3-2. The combined reliability of the preventive SSCs and the SSCs that provide mitigation in conjunction with the initiating event frequency need to satisfy the target frequency associated with the SL of the unmitigated event. Event trees related to each radiological DBE have been developed to represent the bounding hazardous radiological conditions in the SIPD database. The methodology used in the development of DBE frequency information used to demonstrate adequate defense in depth is the same as that used for the risk assessment (section 3.8). For events where the derived frequency including initiating event frequency and failure of both preventive and mitigative controls has minimal margin with respect to the target frequency, an assessment is conducted to determine the impact to the derived frequencies from application of conservative failure data. If inadequate margins exists, control strategies are tailored to ensure adequate defense in depth is achieved.

For chemical hazards, the use of best industry practice (what has been required and judged acceptably safe engineered prevention, control, and mitigation features in industrial plants with a similar chemical hazard), together with the identification of any SDCs, generally satisfy the requirements of defense in depth. Chemical DBEs are evaluated on a case-by-case basis to confirm adequate defense in depth provisions exist.

3.4.6 Summary of ITS SSCs and TSR Controls

The final stage of the DBE discussion is the identification of ITS SSCs and TSR controls. SSCs that meet SDC Exposure Standards Criteria 2.0-1 and 2.0-2, and are found to be important contributors to risk reduction, and key assumptions made in the analysis that if altered or modified could have significant impact on the analysis, are identified and summarized. The summary discussion includes a description of the control elements and their respective safety function(s). The safety function summary identifies what aspect of the SSC or TSR control is being relied upon to reduce the consequence or frequency of the DBE, and the facility conditions or situations in which the safety function is required to be available.

3.5 Hazard Classification

A hazard classification will be performed for the individual WTP facilities and the results documented in the individual facility PSAR volumes. The individual hazard classifications will be performed consistent with the guidance in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. DOE-STD-1027-92 and its attachment provides detailed guidance on a consistent methodology to be used for hazard categorization.

The hazard categorization process provides a method for assessing potential hazards and does not consider potential risk.

The hazard evaluation performed in support of the hazard categorization for each facility provides an understanding of the material which can physically be released. This inventory, either for the facility as a whole, or segmented by facility activities, is compared against the threshold quantities identified in DOE-STD-1027-92, Attachment 1 in order to establish the specific hazard category for the facility. Hazard Category 1 facilities have the potential for significant off-site consequences. Hazard Category 2 facilities have the potential for significant on-site consequences. Hazard Category 3 facilities have the potential for only significant localized consequences.

3.6 Common Cause and Common Mode Design Basis Events

Project-wide common cause and common mode DBEs (for example DBEs with a common initiating event that could impact multiple WTP facilities) will be developed and discussed in future PSAR submittals.

3.7 Seismic Probabilistic Risk Assessment

The top-level safety requirements to which the WTP Project must conform include the radiation exposure standards (RES) presented in Table 1 of DOE/RL-96-0006 and the risk goals presented in section 3.1 of DOE/RL-96-0006. The seismic probabilistic risk analysis (PRA) provides, in part, the means for conformance to these requirements by (1) demonstrating that dose-frequency requirements of the RES table are not likely to be exceeded for seismic events, and (2) providing input on seismic risk to the risk goals evaluation effort.

The seismic probabilistic risk analysis is performed in accordance with *Seismic Probabilistic Risk Analysis Methodology*, RPT-W375-NS00005. Consequences associated with the methodology are assessed in accordance with *Methods for Assessing Consequences of Potential Accidental Radiological Releases from the RPP-WTP Facility Following a Seismic Event*, RPT-W375-NS00006. Preliminary results of the seismic PRA follow.

With its small radiological source term, the LAW vitrification facility is expected to be only a minor contributor with regard to meeting the RES requirements. The approach taken by the seismic PRA for the LAW vitrification facility is to reduce the total number of possible accident sequences to a single sequence with an annual seismic failure probability of one. Furthermore, the approach presumes seismically-induced failure of all vessels and components, major damage to the cell walls and penetrations, and damage to the cell ventilation system such that it is non-functional. From the seismic PRA standpoint, this represents a worst-case scenario. Preliminary results demonstrate that the probability of exceeding any of the RES table values due to seismically-induced accidents originating in the LAW vitrification facility is as required, less than 10^{-6} per year with an adequate amount of margin.

The simplifying approach employed for the LAW vitrification facility cannot be used for the HLW vitrification facility because of the significantly higher radiological sources present in that facility. Therefore, a more complete evaluation of accident sequences and potential dose consequences is required. Preliminary results demonstrate that the probability of exceeding any of the RES table values due to seismically-induced accidents originating in the HLW vitrification facility is, as required, less than 10^{-6} per year with an adequate amount of margin. Furthermore, it is expected that the current on-going HLW requantification effort will produce a significant increase in the margin with which the RES table requirements are met.

Because an earthquake is a common-cause event that could affect the entire WTP site, the above results must be considered preliminary until the seismic risk from the Pretreatment facility has been determined and incorporated. Nevertheless, it is highly unlikely that seismically-induced events within Pretreatment could impact the design of either vitrification facility. This is because Pretreatment releases of sufficient magnitude to do so would also cause Pretreatment facility workers to exceed RES table dose-frequency requirements. Any mitigation features ultimately deemed necessary would therefore have to be applied within the Pretreatment facility and not to the vitrification facilities.

The details of the seismic PRA results will be presented in future revisions of the PSAR. Preliminary findings lead to the conclusion that the seismic PRA results will not affect the HLW or LAW basemat or walls to nominal grade, and are not necessary for the PCAR.

3.8 Adherence to Risk Goals and Results

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) Operations Risk Assessment (RA) was implemented to demonstrate conformance to the risk goals. The results obtained from each of the facility analyses will demonstrate that either e the prescribed risk goals are expected to be satisfied by the current design or identify changes potentially needed to assure future compliance. The WTP Operations RA is being performed in accordance with Appendix E of the *Design Guide for Integrated Safety Management*, 24590-WTP-GPG-SANA-002.

The facility level risk goals to which the calculated WTP Site risks will be compared are defined in one form or another in the following documents:

- *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, DOE/RL-96-0006 (DOE/RL, 1998a)
- *Regulatory Unit Position on Conformance with Risk Goals in DOE/RL-96-0006, RL/REG-2000-08* (DOE/RL, 2000a)
- *Regulatory Unit Position on the Achievement of Adequate Safety, RL/REG-2000-15* (DOE/RL, 2000b)

Preliminary results for LAW and BOF indicate that the risk goal contribution from these facilities will be a minor contribution, less than 1%, to the overall WTP risk goal. These results are based on an analysis of the LAW/BOF design via the ISM process and documented in SIPD as of 10/29/01. The risk goal contribution will be re-quantified as the facility design matures. There are no findings from the Operations RA, which indicate the need to incorporate specific risk informed attributes into the design of the LAW/BOF basemat or walls to nominal grade.

For the HLW facility, the basemat has been designed to accommodate seismic events and loads imposed by drop events. As a result, the RA is not expected to indicate that dropped loads will present unacceptable risks to the receptor populations.

Each phased PSAR submittal identifies the risks to each receptor population for the existing design. Should the design or the inter-facility interface change as the WTP design matures, the risks attributable to each facility will be re-quantified and the results will be documented in future PSAR submittals associated with the specific facility.

Should the calculated cumulative individual risk goal contributions to one or more receptor population approach the allowable threshold, conservatism in existing analyses will be removed. If this reduction in conservatism is insufficient to demonstrate conformance to the risk goals, the design of individual facilities will be adjusted or modified as necessary to ensure that the overall WTP risk goal is maintained. If necessary, this will be done as an optimization analysis, in which the options with the highest risk-benefit ratio are considered first.

3.9 References

WTP Project Documents

24590-WTP-SRD-ESH-01-001-02, *River Protection Project - Waste Treatment Plant Safety Requirements Document, Volume II*

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan*

24590-WTP-GPG-SANA-002, *Design Guide for Integrated Safety Management*

24590-WTP-GPG-SANA-004, *Design Guide for Radiological Consequence Analysis*

24590-WTP-GPP-IT-001, *Use of Quality Affecting Software Applications*

RPT-W375-NS00005, *Seismic Probabilistic Risk Analysis Methodology*

RPT-W375-NS00006, *Methods for Assessing Consequences of Potential Accidental Radiological Releases from the RPP-WTP Facility Following a Seismic Event*

Codes and Standards

10 CFR 835, *Occupational Radiation Protection*, Subsection 1001, "Design and Control", Code of Federal Regulations.

ANSI/ANS 58.9-1981, *Single Failure Criteria for Light Water Reactor Safety-Related Fluid Systems.*

DOE-STD-1027-92. 1992. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, Nuclear Safety Analysis Reports. US Department of Energy, Washington, DC, USA.

DOE-STD-3009-94. 1994. *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*. US Department of Energy, Washington, DC, USA.

IEEE 379-1994, *Application of the Single Failure Criterion to Nuclear Power Generating Station Safety Systems.*

Other References

AIChE. 1992. *Guidelines for Hazards Evaluation Procedures, Second Edition with Worked Examples*. Center for Chemical Process Safety, American Industrial Hygiene Association, Akron, Ohio, USA.

DOE. 1994. *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, DOE-HDBK-3010-94. US Department of Energy, Washington, DC, USA.

DOE-RL. 1996. *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, DOE/RL-96-0006. US Department of Energy Richland Operations Office, Richland, Washington, USA.

DOE-RL. 2000a. *Regulatory Unit Position on Conformance with Risk Goals in DOE/RL-96-0006*, RL/REG-2000-08. US Department of Energy Richland Operations Office, Richland, Washington, USA.

DOE-RL. 2000b. *Regulatory Unit Position on the Achievement of Adequate Safety*, RL/REG-2000-15. US Department of Energy Richland Operations Office, Richland, Washington, USA.

EPA. 1988. *Limiting Values of Radionuclide Intake and Air concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, EPA-520/1-88-020. US Environmental Protection Agency, Washington, DC, USA.

EPA. 1999. *Risk Management Program Guidance for Offsite Consequence Analysis*, EPA 550-B-99-009. US Environmental Protection Agency, Washington, DC, USA.

Hey. 1994. *GXQ 4.0 Program Users' Guide*, WHC-SD-GN-SWD-30002. Westinghouse Hanford Company, Richland, Washington, USA.

NRC. 1982. *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants, Regulatory Guide 1.145*. Nuclear Regulatory Commission, Washington, DC, USA.

NRC. 1998. *Nuclear Fuel cycle Facility Accident Analysis Handbook*, NUREG/CR-6410. US Nuclear Regulatory Commission, Washington, DC, USA.

Schreckhise RG, Rhoads K, Davis JS, Napier BA, and Ramsdell JV. 1993. *Recommended Environmental Dose Calculation Methods and Hanford-Specific Parameters*. Battelle Pacific Northwest Laboratory, Richland, Washington, USA.

Table 3-1 Accident Severity Levels

SL	Facility Worker Consequence	Co-located Worker Consequence	Public Consequence
SL-1	> 25 rem/event	> 25 rem/event	>5 rem/event
SL-2	5-25 rem/event	5-25 rem/event	1-5 rem/event
SL-3	1-5 rem/event	1-5 rem/event	0.1-1 rem/event
SL-4	< 1 rem/event	<1 rem/event	<0.1 rem/event

Table 3-2 Event Target Frequencies

SL	Event Target Frequency (yr^{-1})
SL-1	$< 1 \times 10^{-6}$
SL-2	$< 1 \times 10^{-4}$
SL-3	$< 1 \times 10^{-2}$
SL-4	$< 1 \times 10^{-1}$

Table 3-3 Illustration of Significant Amount of Radioactivity [a]

Vessel	Activity (Curies)	Facility Worker Dose (rem)	Co-located Worker Dose (rem)	Classification
LAW Concentrate Receipt Vessel	500	5.0	0.6	RRC
LAW Melter Feed Preparation Vessel	170	2.5	0.2	RRC
HLW Offgas Drains Collection Vessel	460	0.9	9.6E-3	RRC
LAW SBS Condensate Collection Vessel	0.5	0.03	0.02	NON-ITS
LAW SBS Condensate Vessel	4.7	0.03	0.01	NON-ITS
LAW Submerged Bed Scrubber	1.1	0.03	2.5E-3	NON-ITS

a Values in the table are provided only to illustrate the concept of a significant amount of radioactivity; actual values are provided in the safety analysis report.

Figure 3-1 Integrated Safety Management Methodology for the WTP Project

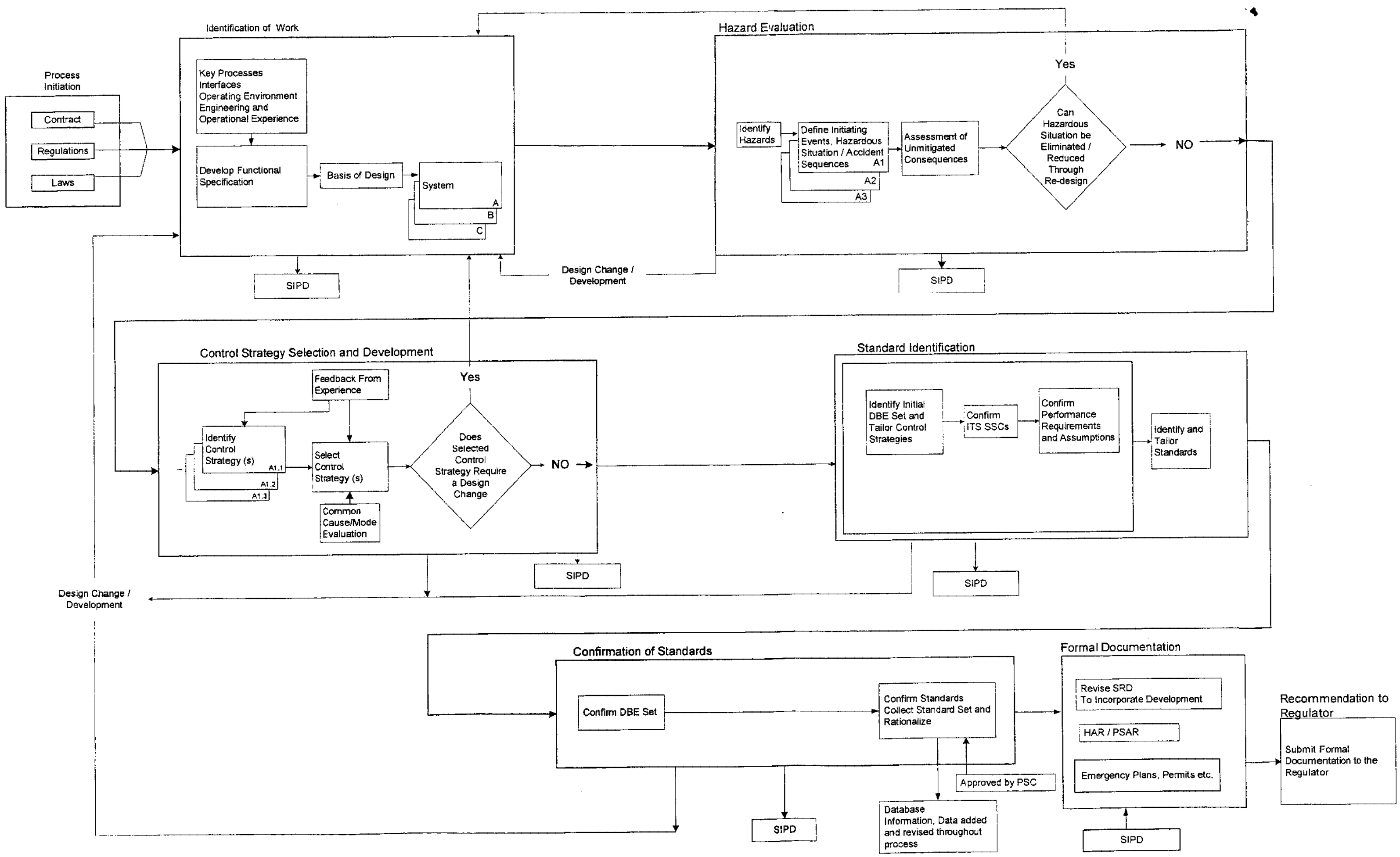
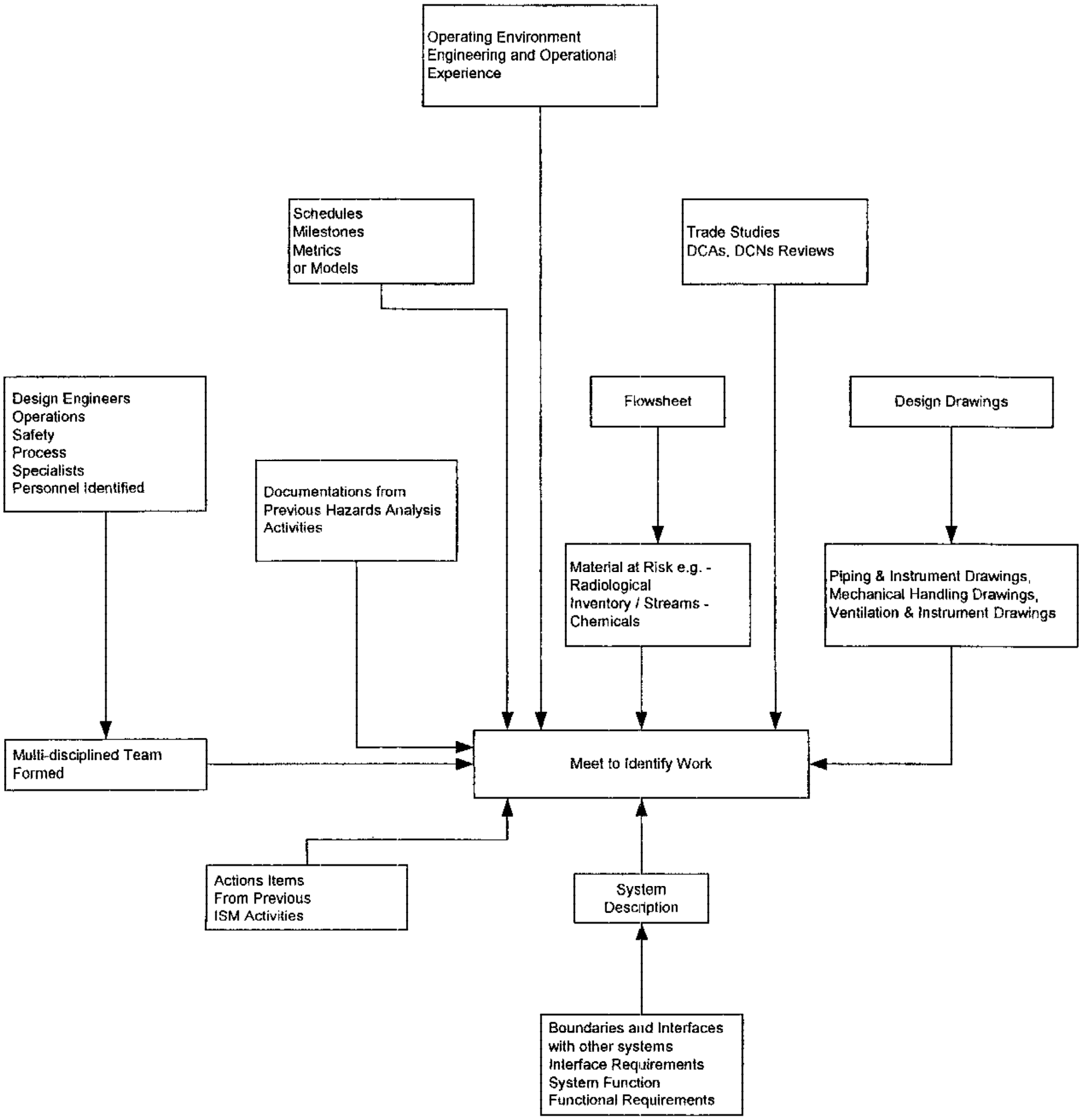


Figure 3-2 Input for the Identification of Work



4 Important to Safety Structures, Systems, and Components

Contents

Tables

4 Important to Safety Structures, Systems, and Components

4.1 Introduction

This chapter describes the information provided in the facility-specific volumes of the Preliminary Safety Analysis Report (PSAR). The information includes the identification of safety design class (SDC) and safety design significant (SDS) structures, systems, and components (SSCs) and, descriptions of their safety-related attributes.

Specifically, this chapter of each PSAR volume will provide:

- Descriptions of the facility SDC and SDS SSCs, including their credited safety functions.
- Identification of support systems the SDC and SDS SSCs depend upon to carry out their credited safety functions.
- Identification of the functional requirements to be met so SDC and SDS SSCs perform their credited safety functions, including environmental conditions caused by postulated accidents under which the SDC and SDS SSCs must operate.
- Identification of the standards applicable to the design, fabrication, erection, construction, testing, and maintenance of the SDC and SDS SSCs.
- Identification of performance criteria that assure functional requirements will be met and an evaluation of the SSC's capability for meeting the performance criteria.
- Identification of assumptions requiring technical safety requirements (TSRs) to ensure performance of the credited safety function.

A principal source of the information used in developing this chapter is the Standards Identification Process Database (SIPD). The data generated by the Integrated Safety Management (ISM) process, Chapter 3.0, and shielding assessments are recorded in the SIPD. The functions of the SIPD include:

- Recording the important to safety (ITS) features of the design and operation of the WTP
- Recording the source, background, or drivers for the ITS features of the design and operation of the WTP including the hazards associated with the facility
- Recording details of SDC and SDS SSCs to which these features apply
- Recording the results of the design codes and standards selection

SDC SSCs prevent criticality, or prevent or mitigate accidents that could exceed public or worker radiological and chemical exposure standards of the *Safety Requirements Document* (SRD; 24590-WTP-SRD-ESH-01-001), Safety Criteria 2.0-1 and 2.0-2. This equipment includes both primary and support SSCs. SDS SSCs achieve compliance with radiological or chemical exposure standards for the public and workers during normal operation or place frequent demands on, or adversely affect the functions of, SDC SSCs if they fail or malfunction. In general, SDC SSCs require more formality than SDS SSCs in establishing functional requirements and design standards.

4.2 Requirements

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Chapter 1.0	Radiological, Nuclear and Process Safety Objectives	Safety Criterion 1.0-8
Chapter 2.0	Radiological and Process Standards	Safety Criteria 2.0-1, 2.0-2
Section 4.1	General Design	Safety Criteria 4.1-2 through 4.1-4
Section 4.3	Engineered Safety Systems	Safety Criterion 4.3-2
Section 4.4	Electrical and Mechanical Systems	Safety Criterion 4.4-2
Appendix A	Implementing Standard for Safety Standards and Requirements Identification	Sections 6.0 through 9.0

4.3 Safety Design Class Systems, Structures, and Components

The following information is provided in the facility-specific volumes for each SDC SSC. In addition, a table is provided in each volume that summarizes the SDC SSCs, their credited safety functions as determined in design basis event (DBE) analyses, the DBEs from Chapter 3 for which the SDC designations are made, and TSR controls.

SDC SSC Identification

This section identifies the SDC SSC at the system level or at the major component level where specifically identified in the DBE analysis.

Credited Safety Function

This section provides the reason for designating the SSC as a SDC SSC and specifically identifies its preventive or mitigative safety function (credited safety function) as determined in Chapter 3, Hazard and Accident Analysis. Other non-credited safety functions of the SDC SSC, if any, are presented in Chapter 3. Non-safety functions are not relevant and are not discussed. The credited safety function is expressed as a top-level statement of the SDC SSC's objective n a given accident scenario. The specific DBE accident analysis(es) associated with the credited safety function(s) is identified.

System Description

This section provides a brief description of the SDC SSC and the basic principles by which the credited safety function is performed. Chapter 2.0 provides a detailed system description including simplified drawings.

A supporting SSC whose failure would result in a SDC SSC losing the ability to perform its credited safety function would be identified. This type of SSC is considered to be a SDC SSC for the specific accident conditions for which the SDC designation was originally made.

Functional Requirements

This section identifies the functional requirements for the SDC SSC to fulfill its credited safety function. These requirements are provided for the specific accidents or situations in which the SDC SSC must function (for example, if an accident is not initiated by an earthquake, the functional requirement does not involve seismic parameters). Functional requirements are specified for the primary SDC SSC and any needed support SDC SSCs. Functional requirements specifically address the pertinent response parameters and non-ambient environmental stresses related to an accident for which the credited safety function is being relied upon.

The non-ambient environmental stresses dictate the bounding operating conditions in which the SDC SSC must perform its credited safety function. Requirements regarding the environmental qualification of a SDC SSC, including considerations for aging, are provided in SRD Safety Criterion 4.4-2. The most severe environmental conditions to which SDC equipment may be subjected during the course of an accident (temperature, pressure, humidity, radiation levels, chemical environment, and so on) are quantified when developing the accident scenario and recorded in the SIPD. These conditions encompass the operating environment during normal operations and off-normal conditions.

The SDC SSC is categorized as a Quality Level 1 (QL-1) item (SRD Appendix A, section 6.0) and the requirements of the *Quality Assurance Manual* (QAM; 24590-WTP-QAM-QA-01-001) are fully applied during its design, fabrication, erection, construction, testing, inspection, and maintenance. QAM Policy Q-02.1 describes the QL-1 classification of items and activities.

For an active SDC system or component, the credited safety function is preserved by applying the defense-in-depth principle so failure of the system or component will not result in exceeding a public or worker accident exposure standard or a serious worker injury. This requirement may be achieved by designing the system or component to withstand a single active failure or by designating two separate and independent systems or components as SDC (SRD, Safety Criterion 4.3-2).

The SDC SSC is designed to withstand the effects of natural phenomena hazards (NPH) and perform the credited safety functions that are required as a result of the natural phenomena event. For example, if an earthquake can produce exposures to the public or workers in excess of standards, the SDC SSC (excepting those so designated based solely on chemical hazards) that prevents or mitigates the exposures is designed to be design basis earthquake-resistant, and designated as Seismic Category I (SRD, Safety Criterion 4.1-3). However, design basis earthquake-resistance is not applied automatically to a SDC SSC. It is applied only when the earthquake is the initiating event, or when the earthquake could cause the initiating event. A SDC SSC that does not have a design basis earthquake mitigating function is designated as Seismic Category III (SRD, Safety Criterion 4.1-4). Tables 1-8 through 1-10 in Chapter 1 define the NPH categories and show the relationships among them.

General and specific design requirements are applied to the SDC SSC as identified in SRD Chapter 4.0, Engineering and Design (SRD Appendix A, section 6.0).

Standards

This section describes the set of standards that were selected for the design, fabrication, erection, construction, testing, inspection, and maintenance of the SDC SSC, and provides a justification of the selected set. The standards are applied in order to ensure the SSC is able to perform its credited safety function (SRD Safety Criterion 4.1-2). They are identified and evaluated for their applicability, adequacy, and sufficiency by the ISM team including work activity experts, hazard assessment experts, hazard control experts, and standards experts. As the WTP design matures, the identification and evaluation process builds on the output of preceding hazard assessment and control strategy development steps.

The identified standards are evaluated and tailored for each SSC based on compliance with applicable laws and regulations, conformance with the DOE-stipulated top level standards, and the following considerations:

- Severity level of the hazard
- Number of independent SSCs that comprise the control strategy
- Control strategy functions - recognizing that a specific control strategy may have multiple functions and serve to control multiple hazards
- Service environment
- Applicable DBEs
- Target reliability for the control strategy*
- Quality level of the SDC SSC

*The target frequencies described in Chapter 3.0 provide a basis for establishing target reliabilities for the SSCs that comprise the control strategy. The combined reliability of the preventive SSCs and the SSCs that provide mitigation must be consistent with the target frequency for the unmitigated event. The reliability of the preventive SSCs will be consistent with the release frequency used to determine the degree of mitigation provided.

The Process Management Team reviews the selected set of standards and recommends their confirmation to the Project Safety Committee (PSC). Following PSC review and confirmation of the standards, a proposed change to the SRD for incorporating the standards is prepared and submitted to DOE for its approval.

System Evaluation

This section provides performance criteria and an evaluation of the SSC's capabilities for meeting them. Performance criteria are imposed on the SDC SSC in order to demonstrate it meets its functional requirements and thereby satisfies its credited safety function. The performance criteria characterize the specific operational responses and capabilities that demonstrate the functional requirements are met. Existing criteria, such as the single failure criterion, may serve as performance criteria.

The SSC evaluation should be as simple as possible, and rely on design information, engineering judgment, calculations, or performance tests.

Controls (Technical Safety Requirements)

This section describes those assumptions requiring Technical Safety Requirements (TSRs) for assuring the SDC SSC can perform its credited safety function. The assumptions are established during the ISM process. TSRs are more completely described in Chapter 5.0.

4.4 Safety Design Significant Systems, Structures, and Components

The following information is provided in the facility-specific volumes for each SDS SSC. In addition, a table is provided in each volume that summarizes the SDS SSCs, their credited safety functions, the justifications for their SDS classification, and TSR controls.

SDS SSC Identification

This section identifies the SDS SSC at the system level or at the major component level where a credited safety function is determined.

Credited Safety Function

This section provides the specific reason for designating the SSC as a SDS SSC (credited safety function). The credited safety function is expressed as a top-level statement of the SDS SSC's objective in a given situation or condition. Non-credited safety functions of the SDS SSC, if any, are presented in Chapter 3. Non-safety functions are not relevant and are not discussed. The situation or condition associated with the SDS credited safety function is identified.

A SSC is designated as a SDS SSC if it is:

- A significant contributor to safety by the analysis that confirms the facility accident risk goals are met. This is one way to identify a SSC that places frequent demands on, or adversely affects the function of, a SDC SSC if it fails or malfunctions.
- Needed to ensure that standards for normal operation are not exceeded (for example bulk shield walls or radiation monitors.
- Selected based on the dictates of nuclear and chemical facility experience and prudent engineering practices.
- A SSC whose failure could prevent a SDC SSC from performing its credited safety function (for example the failure of a Seismic Category II item during a seismic event preventing the credited safety function of a Seismic Category I item, Seismic II over I).

System Description

The content of this section is comparable to the information provided for SDC SSCs.

Functional Requirements

This section identifies the functional requirements for the SDS SSC to fulfill its credited safety function. These requirements are provided for the specific situations in which the SDS SSC must function. Functional requirements specifically address the pertinent response parameters and non-ambient environmental stresses related to the situation for which the credited safety function is being relied upon.

The non-ambient environmental stresses dictate the bounding operating conditions in which the SDS SSC must perform its credited safety function. Requirements regarding the environmental qualification of a SDS SSC, including considerations for aging, are provided in SRD Safety Criterion 4.4-2. The most severe environmental conditions to which SDS equipment may be subjected (temperature, pressure, humidity, radiation levels, chemical environment, and so on) are quantified during the hazards evaluation or accident analyses and recorded in the SIPD. These conditions encompass the operating environment during normal operations and off-normal conditions.

The SDS SSC is categorized as a Quality Level 2 (QL-2) item (SRD Appendix A, section 6.0) and the requirements of the QAM, as determined by a grading process, are applied during its design, fabrication, erection, construction, testing, inspection, and maintenance. QAM Policy Q-02.1 describes the QL-2 classification of items and activities.

The SDS SSC is designed to withstand the effects of NPH and perform the credited safety function required as a result of the natural phenomena event. For example, if an earthquake can produce exposures to the public or workers in excess of standards, the SDC SSC that prevents or mitigates the exposures would be designed design basis earthquake-resistant as discussed in section 4.3. The same NPH loads are applied to a SDS SSC (excepting those so designated based solely on chemical hazards) if failure of the item could prevent the SDC SSC from performing its credited safety function for a design basis earthquake. However, for the seismic response of the SDS SSC, credit may be taken for inelastic energy absorption. Such an SSC is designated Seismic Category II. Design basis earthquake-resistance is not applied automatically to a SDS SSC. It is applied only when the earthquake is the initiating event, or when the earthquake could cause the initiating event. A SDS SSC that does not have a design basis earthquake mitigating function is designated as Seismic Category III (SRD, Safety Criterion 4.1-4). Tables 1-8 through 1-10 in Chapter 1 define the NPH categories and show the relationships among them.

General and specific design requirements are applied to a SDS SSC as identified in SRD Chapter 4.0, Engineering and Design (SRD Appendix A, section 6.0).

Standards

The content of this section is comparable to the information provided for SDC SSCs.

System Evaluation

The content of this section is comparable to the information provided for SDC SSCs except as follows:

SDS SSCs are not required to meet the level of performance criteria associated with SDC SSCs or nuclear standards in general. Performance criteria for a SDS SSC are representative of the general level associated with non-nuclear power reactor industrial and OSHA practices. Performance criteria for a SDS SSC are developed using engineering judgment based on the expected function for which it was designated a SDS SSC and its overall importance to safety.

Controls (Technical Safety Requirements)

This section describes those assumptions requiring TSRs for ensuring the SDS SSC can perform its credited safety function. The assumptions are established during the ISM process. TSRs are more completely described in Chapter 5.

4.5 References

WTP Project Documents

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document, Volume II*

24590-WTP-QAM-QA-01-001, *Quality Assurance Manual*

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan*

Table 4-1 (Example) SDC Structures, Systems, and Components

SDC Structure, System, or Component	Credited Safety Function	Representative and Bounding Accident (Chapter 3.0)	TSR Controls (Chapter 5.0)
Wet Process Cell	Provide confinement of HLW leaks or spills	Leak from HLW concentrate receipt tank (3.4.1.X)	Design Feature (5.6)
HLW Concentrate Receipt Vessels	Provide primary confinement of HLW for the 40 year design life of the facility	Leak from HLW concentrate receipt tank (3.4.1.X)	Design Feature (5.6)
C5 Exhaust Ventilation System:	Provide confinement of airborne releases and filter aerosols to acceptable limits	Leak from HLW concentrate receipt tank (3.4.1.X)	
Ductwork	Provide confinement from the wet process cells up to and including HEPA filter housing		Design Feature (5.6)
HEPA Filters	Filter aerosols to acceptable limits prior to release		Design Feature (5.6) Decontamination Factor & Performance Monitoring (5.5.Y)
C5 Exhaust Fans	Direct aerosols through the HEPA filters and maintain C5 negative to adjacent areas		Monitoring & Controls (5.5.Y)
Monitoring and Control System	Ensure exhaust fan operability and HEPA filter performance		Monitoring & Controls (5.5.Y)
Power Supply System	Ensure exhaust fan operability		BOF Interfacing Control (5.7.Y)

Table 4-2 (Example) SDS Structures, Systems, and Components

SDS Structure, System, or Component	Credited Safety Function	Justification of SDS Classification	TSR Controls (Chapter 5.0)
Entries in this table are comparable to Table 4-1 information.			

7 Radiation Protection

Contents

7 Radiation Protection

7.1 Introduction

The *Radiological Control Program* (24590-WTP-PL-NS-01-001) describes how requirements for ensuring radiation safety are addressed by the project. The key document within the Radiological Control Program is *Radiation Protection Program for Design and Construction* (24590-WTP-RPP-ESH-01-001). 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), and *RPP-WTP ALARA Program* (24590-WTP-PL-NS-01-002).

The Radiation Protection Program meets the requirements of *Occupational Radiation Protection* (10 CFR 835). The remaining contents of the Radiological Control Program meet the additional requirements specified below.

7.2 Requirements

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Section 1.0	Radiological, Nuclear, and Process Safety Objectives	Safety Criterion 1.0-10
Chapter 5.0	Radiation Protection	Safety Criteria 5.0-1
Section 5.1	Occupational Radiation Protection	Safety Criteria 5.1-2
Section 5.3	Environmental Radiation Protection	Safety Criterion 5.3-8

Integrated Safety Management Plan (ISMP; 24590-WTP-ISMP-ESH-01-001)

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 7
1.5	Compliance With and Implementation of 10 CFR 835	Chapter 7, "Radiation Protection"
1.5	Radiation protection design	7.3, "Radiation Protection Design"
1.5	ALARA design	7.4, "ALARA Design"

10 CFR 835, *Occupational Radiation Protection*

7.3 Radiation Protection Design

Radiation protection design addresses shielding and access control features, as well as radiation monitoring. Each of these is addressed in the following sections.

7.3.1 Radiation Shielding and Access Control Features

The WTP is divided into radiation zones. The zoning reflects the intensity of the radiation sources in the area, if any, and the anticipated personnel access requirements. Maximum allowable exposure rates in accessible areas are defined to ensure that personnel exposure standards are not exceeded. Shielding requirements are then established as necessary to ensure that the exposure rates in the radiation zones are maintained under all anticipated operating conditions and that commitments to ALARA are satisfied. Shielding and access control features are provided in accordance with 10 CFR 835 and additional criteria provided in SRD Volume II, Chapter 2.0, "Radiological and Process Standards", and Chapter 5.0 "Radiation Protection".

Radiation protection features such as facility zoning, minimum shielding requirements, and access control features will be documented on applicable facility layout drawings and other design documents. These documents are reviewed to ensure that the requirements are met. Details, such as penetrations are analyzed to ensure that potential streaming paths are identified and properly shielded.

7.3.2 Radiation Monitoring

Fixed area radiation monitoring is provided in areas where the area exposure rates may change suddenly. These sudden changes may be a result of process operation or maintenance activities. Continuous air monitors are provided in accessible locations where concentrations of airborne radionuclides may vary. Air sampling capability is also provided. Effluent sampling is provided as necessary to demonstrate compliance with regulations. The radiation monitoring locations will be shown on drawings developed during detailed design.

7.4 ALARA Design

Project procedures are established to implement an ALARA program. These procedures include guidance on ALARA design considerations appropriate to the facility and delineate the ALARA design responsibilities of individuals on the project. The ALARA guidance is derived from DOE G 441.1-2, *Occupational ALARA Program Guide*. The ALARA guidance addresses considerations for reducing exposures within the WTP from operations and from final decommissioning activities. It also addresses considerations for reducing effluents from the WTP.

ALARA design criteria and ALARA design considerations are provided to project staff in controlled documents. These criteria and considerations are arranged by topic area (for example, General Criteria, Dose Criteria, Environmental Criteria, Facility Arrangement Considerations, Shielding Considerations, System Design Considerations, etc.). Design engineers are responsible for implementing and documenting ALARA design criteria and ALARA design considerations in their work. Supervisors are responsible for ensuring that individuals in the group are trained in ALARA criteria and considerations, and for reviewing designs against those criteria and consideration. The WTP ALARA program also requires an ALARA review of proposed changes to the facility.

Periodic interdisciplinary project ALARA reviews are conducted to ensure that ALARA concepts are being integrated into the design and to discuss implementation of the ALARA design goal and the rationale for exceptions from specific ALARA design considerations.

In addition, collective exposure estimates assess projected exposures to provide insight into the sources of exposure and indicate areas that may require additional attention. The estimates are compared to those from similar operating facilities.

Radioactive systems at the WTP are designed to minimize the potential for leaks of radioactive material. Radioactive leaks are collected and segregated from non-radioactive waste streams. To the extent possible, radioactive leaks are returned to the process stream.

Melter offgas streams are treated to scrub out radioactive particulates before passing through filter media. The scrub streams are returned to the process stream.

The interfaces between non-radioactive service systems (e.g., cooling water) and radioactive systems are designed so that any leakage is from the clean side to the radioactive side of the interface. In cases where this ALARA design practice is not technically feasible, engineering design features are furnished to ensure alternate contamination control provisions are incorporated.

The confinement system design and access control features described above serve to minimize the spread of radioactive contamination in the WTP. During operation, movement of clean materials into potentially contaminated areas is minimized to aid in contamination control, minimize replacement and survey costs, and minimize radioactive waste volumes and costs. Tools in contaminated areas are controlled and reused to the extent possible.

7.5 Radioactive Contamination Detected During Construction

The WTP construction site characterization study, documented in HNF-2067, Rev. 0, *TWRS Phase 1 Privatization Site Pre-construction Characterization Report*, indicates radiological conditions consistent with Hanford Site-wide background levels. However, due to the potential for encountering legacy radioactive material during construction activities, the WTP project will implement a radiological monitoring program to assure site personnel and public radiological safety. The periodicity and type of radiological surveys performed during construction will be determined by the programs and procedures specified in the RPP. BNI does not intend to perform additional site characterization and will establish a monitoring program initially based on the characterization specified in HNF-2067. Background determinations will be based on the Hanford Site background determination. An initial radiological survey has been performed to confirm radiological conditions of the construction site. Currently, the site is not under radiological control and is not posted as a radiological area. If an area of the construction site is determined to be contaminated it will be placed under radiological control. Subsequent surveys will be performed to confirm that radiological conditions have not changed, with the frequency based on the amount of earth moved. The survey frequency will be determined by the amount of radioactivity detected, with a target frequency of quarterly. If significant excavation occurs, as expected at the initial stages of construction, then surveys will take place daily. Should the survey indicate radioactivity is routinely detected (the number of contamination events is more significant than the specific contamination level of each event) or a condition changes, such as high level radiological work performed by another contractor adjacent to the WTP construction site, the survey frequency will be increased commensurate with the risk and good health physics practices. Surveys will also be conducted after periods of sustained high winds. This is intended to mean that during environmental conditions that transport a distinguishable accumulation of vegetation to the WTP construction site, additional radiological surveys of the vegetation will be performed. If radioactivity is detected, the transport path of the vegetation across the construction site will be surveyed. In addition to the biological and environmental transport vectors, the remote possibility exists that unidentified radioactive discharges were previously conducted at the location now being used to construct the WTP. Because of this, surveys of the spoil pile will be conducted after an excavation depth of approximately 15 - 20 feet or if excavation is stopped due to the discovery of unexpected buried debris or material. The requirements and considerations for establishing and modifying a radiological survey frequency are described in the *River Protection Project - Waste Treatment Plant Radiological Control Manual*, article 551.

The radiological monitoring program is designed to detect radioactive material or conditions above existing background levels and to ensure prompt identification and response to conditions warranting protective measures in accordance with 10 CFR 835, *Occupational Radiation Protection*. Procedures address construction site response to off-normal radiological conditions in support of implementation of the RPP. Limiting doses in accordance with the requirements of 10 CFR 835 per the RPP implementing procedures will ensure conformance to public dose standards in SRD Safety Criteria 2.0-1 and 2.0-3 in the event that contamination or buried waste are encountered. If contamination is detected that requires one RCT more than eight hours to verify the boundaries and remediate, the area will be posted, work activities in that area stopped, and OSR will be notified.

The RPP implementing procedures:

- Include action levels that will trigger mitigative actions if radioactive contamination above background levels is encountered
- Provide controls on radioactive contamination encountered during limited construction activities and the release of materials and property containing residual radioactive contamination (SRD Safety Criterion 5.3-8 is applicable to limited construction activities)
- Provide methods to limit and control the spread of radioactive contamination
- Provide methods to collect, document, store, and retain all contamination and exposure records

The RPP implementing procedures and programs described above will ensure that an inadvertent release of radioactive material to the environment will be managed and controlled such that the impacts to the environment and exposures to the public are kept as low as reasonably achievable (ALARA). These procedures and programs will be consistent with 10 CFR 835.

Should it occur, the discovery of legacy waste will be recorded, reported, and evaluated as described in section 17.4.7, *Occurrence Reporting*. The radioactive emission license includes conditions to address environmental radiological protection requirements should radioactive contamination be encountered during construction excavation activities.

7.6 References

WTP Project Documents

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan*

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

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

24590-WTP-PL-NS-01-002, *RPP-WTP ALARA Program*

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document, Volume II*

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

Codes and Standards

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

12 Procedures and Training

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12 Procedures and Training

12.1 Introduction

Structured processes for developing, maintaining, and delivering procedures and training have been implemented for the design and construction phase of the project and similar processes will be implemented as the project moves to commissioning and operations. These processes are documented in approved project administrative procedures. Work is planned and performed in accordance with established controls. This ensures repeatable, predictable operation that complies with regulatory requirements and implements safe work practices. The rigorous approach to procedure development, the performance-based approach to training, and the emphasis on following procedures when performing work, demonstrates the project's commitment to working in accordance to established controls. During facility operations, these processes will ensure that the safety hazard and accident analyses summarized in Chapters 3.0 of the Final Safety Analysis Report (FSAR) form the basis of the technical content of operating procedures and training for normal, off-normal, and emergency conditions. These processes will also ensure specific procedures and training, described in other chapters of this document, are systematically developed and maintained. Other chapters of the Final Safety Analysis Report (FSAR) that will contain specific requirements for training or procedures include:

- Criticality Safety (Chapter 6.0)
- Radiation Protection (Chapter 7.0)
- Hazardous Material Protection (Chapter 8.0)
- Waste Management (Chapter 9.0)
- Initial Testing, Operational Safety, In-service Surveillance, and Maintenance (Chapter 10.0)
- Conduct of Operations (Chapter 11.0)
- Quality Assurance (Chapter 14.0)
- Emergency Preparedness (Chapter 15.0)
- Management Organization, and Institutional Safety Provisions (Chapter 17.0)
- Fire Safety Program (Chapter 18.0)

12.2 Requirements

The requirements that form the basis for the facility procedures and training programs are found in:

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Section 4.0	Engineering and Design
Section 4.0-4.2	Safety Criterion
Section 7.2	Training and Procedures
Section 7.2-1 - 7.2-8	Safety Criterion
Section 7.3	Quality Assurance
Section 7.3-3 - 7.3-5	Safety Criterion

Integrated Safety Management Plan (ISMP; 24590-WTP-ISMP-ESH-01-001)

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 12
1.5	Training and Qualification	Section 12.4, "Training Program"
1.5	Procedures	Section 12.3, "Procedures Program"
1.5	Development of Operator Training Program	Section 12.4, "Training Program"
1.5	Mechanical Integrity	Chapter 12, "Procedures and Training"

Other

QAM-24590-01-00001	Quality Assurance Manual, Policy Q-02.2, Personnel Training and Qualification, Policy Q-05.1, Instructions, Procedures, and Drawings

12.3 Procedures Program

12.3.1 General Information

The WTP as a project is committed to meeting requirements and standards for protecting the safety and health of project workers, the public and the environment and for ensuring that work is planned, performed, and documented. Implementation of these expectations is achieved through a procedure management system that encompasses the development, review, approval, distribution, use, and revision of procedures. Project procedures are prepared to provide explicit instructions for accomplishing work and to support management control functions and technical work activities. Administrative procedures are used to implement management controls functions, control the interactions among WTP project organizations, and assist in ensuring that work is performed systematically and correctly. Procedures are prepared during the appropriate phases of the project, to support activities such as:

- Configuration Management
- Design
- Construction
- Testing
- Startup
- Operations
- Periodic Surveillance
- Maintenance
- Emergency Management
- Fire Protection
- Training and Qualification
- Work Planning

- Quality Assurance
- Management Assessments
- Safeguards and Security
- Radiation Safety
- Criticality Safety
- Chemical Process Safety
- Environmental Protection
- Incident Reporting and Investigation
- Human Factors
- Deactivation and Decommissioning
- Records Management

Procedure management programs include mechanisms to collect and respond to feedback on procedure improvements. These mechanisms include activities such as user feedback, incident investigations, and audits and assessments.

12.3.1.1 Design and Construction Phase Procedures Program

The WTP project meets its commitment to working in accordance with established management controls during design, engineering, and construction phases through implementation of a Procedures Management System (PMS). This system supports safe work planning, maintains compliance with regulatory and quality requirements, encourages employee involvement, and actively seeks out constructive feedback and continuous improvement. The PMS is an essential part of the Integrated Safety Management System (ISMS) and is modeled after the (draft) US Department of Energy (DOE) document titled, *DOE Principles for Excellence in Procedure Systems*.

Figure 12-1 shows the origin of project requirements and the flowdown of these requirements to implementation. Applicable state and federal laws and legal requirements are incorporated in the prime contract for the project. These contractual obligations require the project maintain compliance with applicable federal, DOE, state, and local regulations and requirements for non-radiological worker safety and health; radiological, nuclear, and process safety; quality assurance (QA); and environmental protection.

The Authorization Basis (AB) for the project (included in the requirements documents block on Figure 12-1) is established in cooperation with DOE, and provides the safety, quality, and administrative control requirements for radiological, nuclear and process safety during the design, construction, operation, maintenance, and deactivation of the WTP. The AB also serves as the benchmark against which a proposed change to the facility, or procedures, programs, plans, or management processes is evaluated for potential safety, quality, and regulatory implications. Project documents such as management directives, policy statements, plans and charters impose management expectations, describe programmatic processes, establish functional or organizational plans, or assign responsibilities for accomplishing project goals.

Procedures and other documents described in the Quality Assurance Manual (QAM) as implementing documents incorporate the regulatory requirements defined in the documents in the upper three levels of Figure 12-1 and provide auditable, traceable implementation of these requirements. Procedures are required when a defined task or activity accomplishes work or for activities defined in the QAM or other AB or requirements document.

Procedures are reviewed by affected departments, maintained consistent with the AB and other Project requirements, and have identified owners responsible for ensuring adequacy and implementation of requirements. The identified owner organization performs a final assessment before approval to ensure the procedures are technically accurate, and consistent with management expectations. Procedures are approved by the management reviewer(s) with responsibility and accountability for the work activities covered in the procedure. The Project Administration Document Control (PADC) Department provides a controlled delivery system that allows WTP personnel access to controlled, current versions of approved and released procedures.

Project procedures and the PMS assist in implementation of ISMS components by:

- Defining the scope of work - procedures translate processes and applicable requirements into an approved, controlled set of work instructions.
- Addressing the hazards - Potential hazards associated with a scope of work are identified during the procedure development process.
- Developing and Implementing Hazard Controls - Procedures are written by qualified personnel in accordance with established safety and technical requirements and standards. Procedure writers consult subject matter experts, as necessary, during the procedure development process and technical reviews of the procedures, and ensure that completed procedures implement safety, administrative, design, operating, and quality controls.
- Directing Work within Controls - Procedures provide accurate and authorized information and direction to enable individuals to perform assigned tasks safely and effectively.
- Providing Methods for Feedback and Continuous Improvement - Procedures are developed using the review and approval feedback loop. Comments are solicited and resolved prior to issuance. Updates, corrections, or improvements to the approved procedures are accomplished through user feedback. The management assessment and corrective action programs provide mechanisms for identifying continuous improvement opportunities of both the procedures and the procedure processes.

12.3.1.2 Operational Phase Procedures Program

Project activities will be conducted in accordance with procedures. The WTP procedures organization, will develop, maintain, and control procedures in conformance with applicable federal and state regulations, industry standards and codes, and the SRD criteria or procedures. The project QA manual and implementing procedures will control WTP work processes. All management control processes that support important to safety equipment and SAR assumptions or results will be performed in accordance with written procedures.

Procedure development and control processes will be governed by administrative procedures that define minimum requirements for technical procedure development and use, including processes for the identification of need, preparation, review, approval, change, revision, use, and periodic review of procedures for operations, testing, surveillance, modification, and maintenance activities

Procedure users will use and comply with approved technical procedures as required by an assigned classification code (except when an employee received direct management or supervisory approval during emergency or off-normal conditions). WTP administrative procedure instructions for using and complying with procedures will be different depending on the classification code. Classification descriptions for technical procedures include:

- Step by step - the nature of the task requires this type of rigor because (1) potential difficulties are present either through the complexity of the procedure, the nature of the work, or the task affecting other components within a more sensitive system or (2) a safety problem or damage to the equipment could occur if this procedure is not followed correctly.
- General intent - those procedures where the task can be accomplished using the skill of the user; indicates that the task is performed routinely; and indicates there is little to no liability to personal safety, economic value, the environment, or equipment failure if performed out of sequence.

The WTP procedures organization will be responsible for providing facility organizations with the most recent version of all applicable procedures. It will be the line management's responsibility to supply controlled copies of procedures and instructions at work locations and to train workers on identifying and using the current procedure revision. The procedure user will have the responsibility to ensure that the procedure to be used is the most current.

WTP administrative procedures will require that procedure users stop work if the work cannot be accomplished as described in the procedure or if accomplishment of the work would result in an undesirable situation. The procedure user will be required to notify supervision of the problems.

12.3.2 Development of Procedures

12.3.2.1 Design and Construction Phases Procedure Development

At WTP, the processes for developing, issuing, revising and canceling procedures and other administrative documents is governed by administrative procedures that have been reviewed by affected organizations, and approved by responsible management.

The determination of when a procedure is necessary is based on the flow-down of requirements, risk, task complexity, quality, and safety considerations. Guidance on format, content, and presentation of materials is provided by the procedure on procedures.

Procedure reviews by affected organizations are required to ensure appropriate administrative and engineering controls are incorporated. These reviews also ensure that proposed processes effectively mitigate identified hazards, and satisfy quality assurance requirements.

The WTP document control system is administered by the PADC Department. This system provides a controlled electronic delivery system of approved procedures and includes an index that lists all approved procedures, by title, number, and revision.

12.3.2.2 Operational Phase Procedure Development

Safety Requirements Document (SRD), section 7.2-5 requires procedures be developed for anticipated operations, evaluations, tests, and off-normal or emergency situations. The extent of detail in a procedure will depend on the complexity of the task, the experience and training of the user(s), the frequency of performance, and the significance of the consequences of error. Administrative procedures will delineate the process and requirements for the preparation or modification of both technical and administrative procedures. The procedures covering the following topics will be identified prior to Operations Authorization:

- 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
- Emergency response activities (including radiological and hazardous chemical release)

Management control system procedures will address methods to control hazards during operations and maintenance. Procedures will describe safe work practices to control hazardous processes and operations including lockout/tagout, confined spaces, opening process equipment and piping, and control over entrance into a facility. These procedures will delineate allowed activities for facility workers, vendors, contractors and visitors, and describe emergency response actions.

Steps in the technical procedure development process are illustrated in Figure 12-2 and are described in the following subsections.

- Identify the need. Technical procedures will be developed for anticipated operations, transients, evolutions, surveillances, maintenance, and off-normal or emergency situations. The need for a new or revised procedure may be identified under the following circumstances:
  - When modifications in the conduct of an operation are implemented
  - When equipment or systems are modified
  - When a procedure is deemed inadequate during task performance
  - As a result of a periodic review of technical procedures

- Develop the technical basis. During technical draft development, a subject matter expert will gather information that will lead to identifying the sequence of steps that should be performed in a particular process (i.e., the technical basis for the procedure). Typical source documents used in developing the technical basis for a procedure will include:
  - Final Safety Analysis Report
  - Technical Safety Requirements (TSR)
  - Safety Evaluation Report
  - Safety Requirements Document
  - System Design Descriptions

- Facility configuration
- Vendor information
- Operational lessons learned
- Functions and requirements documents

- Prepare and review the draft. Draft procedures will be prepared consistent with administrative procedure requirements. A writer's guide will be used to ensure the:
  - Format and content of each procedure is consistent
  - Procedure steps are written to effectively communicate the required actions
  - Procedure steps and precautions effectively communicate operating, safety, administrative, design, and quality control limits
  - Procedure incorporates human factors that lead to effective procedure use

The need, scope, applicability, and basis of each procedure will be documented either in the procedure itself, or in a history file.

Technical review and verification will ensure the technical accuracy of a procedure, and compare the procedure against the appropriate source document requirements such as system design descriptions, functions and requirements documents, DOE orders, technical requirements, regulatory requirements.

Technical procedure validation will be a review of a procedure performed by the end user to ensure its usability and correctness. This review, usually performed at the work location, will validate that the procedure provides sufficient and understandable guidance and direction to the user and that the procedure is compatible with the equipment or system being maintained.

- Review and approve the procedure. New procedures, procedure revisions, and technical changes to procedures will be reviewed and approved according to requirements contained in WTP administrative procedures. Approval authorities will be assigned to verify that environmental, safety, health, and quality assurance requirements have been properly addressed. Document approval will be indicated by a signature to release and use the procedure. All WTP administrative and technical procedures will be assigned a procedure and revision number. A record copy will be placed into a procedure master file, and working and controlled copies of the procedures will be made available to procedure users.

12.3.3 Maintenance of Procedures

12.3.3.1 Design and Construction Phases Procedure Maintenance

Feedback and continuous improvement is integrated in the procedure management program through a variety of processes. These processes gather information concerning the adequacy of procedures and work processes. Opportunities for improving the definition, planning, and performance of work are identified and developed. Examples of these feedback and improvement processes include:

- Lessons learned
- Procedure change processes

- Management and self assessments
- Periodic reviews
- Independent assessments
- Corrective actions
- Post-job reviews
- Audits

12.3.3.2 Operational Phase Procedure Maintenance

The safety of WTP facilities and personnel will depend on the availability of operating, maintenance, and alarm response procedures that correspond to the current plant configuration. To ensure personnel use only the most current procedures, the WTP will implement a process that provides timely review, approval and control of new or revised procedures. This process for technical procedure maintenance and review will be documented in administrative procedures.

Training needs related to procedure revisions will be determined by the line manager responsible for the procedure being revised. This determination will be based upon the significance of the change. For changes that require new skills or knowledge, the line organization will request the training department to assist in determining a training need. Employees are required to read revisions that apply to their duties prior to implementation of the revisions and are required to document this training per WTP administrative procedures. The line organization would denote no action for changes that are editorial or not deemed significant.

12.3.3.2.1 Procedure Changes

To ensure procedures continue to be technically and administratively accurate and they incorporate appropriate facility design, safety analysis operation, and vendor technical information, needed changes will be controlled by a process that requires a review and screening of the changes, including a screening for facility impact. This procedure change process will be used to proceduralize modifications to important-to-safety (ITS) structures, systems and components (SSCs), processes, or requirements; and to correct procedural errors, ambiguities, and human factor deficiencies that could result in personnel error or unsafe job performance. Procedure modifications can result from issues identified during training activities and from efforts to resolve occurrences resulting from personnel errors or equipment malfunctions.

The level of review and approval for procedure changes will depend on the scope of the recommended change, and the approval process will be addressed in WTP administrative procedures.

12.3.3.2.2 Periodic Review of Procedures

WTP administrative procedures will require that procedures be reviewed at periodic intervals to ensure information and instructions are technically accurate and appropriate human-factor considerations have been included. This process will specify that operations and maintenance procedures affecting ITS SSCs will be reviewed at least every two years. Procedures that implement the requirements identified in TSR administrative controls will be reviewed at least every three years.

12.4 Training Program

12.4.1 General Information

Personnel training and qualification is viewed by WTP facility management as essential in achieving quality performance and in protecting workers and the environment. The senior manager during each project phase will have the overall responsibility for maintaining a qualified workforce for the facility. Line managers will be responsible for the content and effectiveness of training and qualification processes, and a facility training manager will be designated and assigned responsibility for developing and implementing facility training programs.

12.4.1.1 Training During Design Phase

WTP management recognizes the importance of adequate training and development of people in the achievement of safety and health of the workers, public, the protection of the environment, and the achievement of quality. To this end, a training and development program for the design-phase of the project has been developed. The primary objectives of this program are to ensure personnel involved in the Project achieve and maintain the capabilities required to perform their assigned tasks safely.

Management hires people who are qualified by education, training, and experience to fill established positions. Functional and line managers are responsible for development of a training profile for each employee based on applicable job descriptions and task assignments. When knowledge and skills specific to the WTP project or to an assigned task are required, task specific training and assessments are provided. Training is concentrated primarily in the areas of design evolutions, compliance with regulations and commitments, QA, and other management control processes.

Once training needs have been identified, suitable instructional methods are selected for training on each subject. Instruction methods include classroom training, computer based training, and reading assignments. Classroom trainers are selected based on knowledge of the subject matter and qualifications for leading the training.

A training department has been established to plan, coordinate, and implement training program. This department takes a graded approach to implementing training, meaning the level of training and testing is commensurate with importance to safety and quality of the results. Written procedures are established for the formal training of personnel, and for ensuring only those individuals who meet their requirements are permitted to perform the organization activities. These training and qualification procedures and the training system described in this section apply to all WTP Project personnel and subcontractor employees. Responsibilities of personnel involved in implementation of the training program are defined in these training procedures. The WTP Training Manager is assigned responsibility and accountability for the implementation of the training program and for periodic evaluation of its effectiveness.

Refresher training is provided to comply with periodic training requirements specified in applicable federal and state regulations or to maintain required certifications. In addition, management specifies retraining on certain subjects based on preservation of high standards of safety and quality. Records of the identification of training needs and training performed are maintained in accordance with Project Document Control procedures.

12.4.1.2 Training During Facility Construction

A training and development program for the construction phase of the project has been developed. The primary objectives of this program is to ensure that the personnel involved in the Project achieve and maintain the capabilities required to perform their assigned tasks safely. When knowledge and skills specific to the project or to an assigned task are required, task specific training and assessments are provided both for manual and non-manual workers.

Manual workers are qualified at the time of hiring by training and experience to fill established positions. Project construction management is responsible for development of a training profile for manual worker job classifications. Training for manual workers is concentrated primarily in the areas of industrial safety, fire protection, appropriate Hanford site employee training and QA.

Non-manual workers are qualified at the time of hiring by education, training, and experience to fill established positions. Functional and line managers are responsible for development of a training profile for each non-manual employee based on applicable job descriptions and task assignments. These non-manual workers are included in the training program described in section 12.4.1.1 above and in construction phase specific training. Training is concentrated primarily in the areas of design evolutions, construction activities, compliance with regulations and commitments, QA, and other management control processes.

Once training needs are identified, suitable instructional methods are selected for training on each subject. Instruction methods include classroom training, computer based training, videos, and reading assignments. Classroom trainers are selected based on knowledge of the subject matter and qualifications for leading the training.

Construction management has assigned personnel to plan, coordinate, and implement an effective training program. Written procedures are established for the formal training of personnel, and for ensuring only those individuals who meet their requirements are permitted to perform construction activities

Refresher training is provided to comply with periodic training requirements specified in applicable federal and state requirements or to maintain certain certifications. In addition, management specifies retraining on certain subjects based on preservation of high standards of safety and quality. Records of the identification of training needs and training performed are maintained in accordance with PDC procedures.

12.4.1.3 Training During Facility Operation

The training and qualification standards and the training system described in this section apply to WTP facility personnel and subcontractor employees performing operations, maintenance, and technical support work at the facility.

The goal of training during the operational phase will be to ensure that personnel engaged in activities affecting safety attain the ability to work safely and are qualified to perform their duties. Specific objectives of training will include: understanding processes thus improving technical ability; increasing awareness of hazards and the value of engineered and administrative controls that function to prevent and mitigate the hazards and hazardous situations; enhancing communication skills and effectiveness of supervision; demonstrating worker qualifications; and establishing a safety culture. The training system described herein will incorporate these objectives to serve as the management tool for analyzing training needs, and designing, developing, conducting, and evaluating training.

The types of training provided at the WTP facility will fall into the following general categories:

- Training specific to activities that implement requirements contained in the AB.
- Performance-based specialized training is provided for key personnel employed in particular operations, maintenance, technical support, and supervisory positions tailored to their involvement with important-to-safety activities resulting from the PSAR. A simulator package may be provided to support operational training including process emergencies.
- Regulations applicable to establishments that handle radioactive and hazardous material require that all personnel, including vendors, subcontractors and visiting personnel are trained in how to conduct themselves on the site, respond to alarms, and use personal protective equipment and emergency response equipment, depending on the nature of their work.
- Employees new to the facility require training to a minimum level of awareness and capability to perform their assigned duties.
- Training specific to facility or process modifications and new technology is provided, or training is provided when personnel are transferred to new areas of work.
- Special training is provided when normal skills and expertise are to be employed in unusual circumstances such as during non-routine maintenance, infrequently performed activities, or in response to emergencies.
- Refresher training in routine activities (e.g., radiation protection) is provided to ensure competency is maintained.

The facility will be staffed and managed to plan, administer, evaluate, and control a systematic process that accomplishes job-related training needs. The training and qualification system will be documented and implemented as described in WTP facility procedures to ensure training activities are consistently and effectively conducted. The WTP Training Manager will be assigned responsibility and accountability for the implementation of the training program and for periodic evaluation of its effectiveness.

Facility procedures will define the responsibilities and roles, authority, and accountability of other personnel involved in managing, supervising, and implementing training programs. Specific facility procedures will describe the qualification and requalification process, personnel selection requirements, procedures for development, review, approval, and control of training materials, conduct of on-the-job training (OJT), control of on-shift training, conduct of drills, and administration of training examinations.

Line managers, in conjunction with operations and technical support training personnel, will have the primary responsibility for conduct of the training programs and will be responsible for providing the resources necessary for their staff to participate in training required for their job function. WTP facility management will be involved in the implementation of training programs by providing performance objectives and approvals regarding training needs and the content of instructional materials. In addition to ongoing performance monitoring by line management, periodic assessments will be conducted as part of the training program evaluation process.

The WTP facility training plan will describe the initial, continuing, and refresher training requirements for key personnel whose level of knowledge and skill will be important to safe facility operation. The training plan will also contain minimum education, experience, and medical (if applicable) requirements for each identified position and will specify the training and any special qualifications that are required. As a minimum, formal training will be provided to the following personnel:

- Facility staff members (for example, basic radiological, chemical, criticality, industrial safety)
- Process operators
- Technicians (for example, laboratory, radiological control)
- Maintenance personnel
- Emergency response personnel
- Supervisors and managers
- Technical instructors
- Visitors allowed unescorted access
- QA personnel
- Subcontractor employees who perform any of the above jobs at the facility

Initial and continuing training programs will be established to ensure individuals are qualified to perform job requirements, to maintain proficiency, and to ensure safe facility operations. Classroom training and OJT will be conducted by designated, qualified individuals. Qualifications for instructional personnel will be specified in the training plan. Personnel new to the WTP Facility or changing to a position for which they have not received training, will complete required training within a specified period after starting the assignment. Personnel who have not received training can work only under the supervision of trained personnel.

Individual training profiles will be tailored to match the employee's role in the organization and will specify minimum amounts and types of training and testing that must be completed before qualification is obtained. Operations personnel in training will be supervised and controlled to ensure the appropriate information is being learned and to use trainee time effectively. Supervision will ensure that operator are taught to rely on engineered features and to avoid mistakes during operational activities.

Initial training will consist of the appropriate combination of required reading, self-study, classroom lectures, computer-based training (CBT), OJT, and performance evaluations. Facility control system simulators and prototype melters may be used, as appropriate, to provide a low-risk training environment for operational and maintenance personnel to support testing activities. Initial training programs will include, as applicable, training on basic theory and fundamentals, principles of facility operation and operating characteristics, facility systems, and normal, off-normal, and emergency operating procedures. Exceptions from training will be granted when justified and approved by management; the exception process will be controlled by WTP training procedures. OJT and task qualifications will be completed by actual task performance. When the actual task can not be performed, walk through training will be utilized and provisional qualification granted.

Continuing training will be administered on a two-year cycle and will include an appropriate combination of required reading, self-study, classroom training, CBT, OJT, and performance evaluations. Training content will be tailored to the position and may include topics that cover significant changes to facility, SSCs, and procedure changes; operating experience feedback; training to correct identified performance problems; and selected fundamentals, including seldom-used knowledge and skills necessary to ensure safety. Employees involved in operating a process will be trained in an overview of the process and in the operating procedures and instructions. The training will include emphasis on the specific safety and health hazards, operating limits, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks. As applicable, continuing training will include feedback from lessons learned from performance events at WTP and from industry events. For emergency responders, training will also include drills on off-normal or accident situations and use of facility systems to control or mitigate accidents.

12.4.2 Development of Training Material

12.4.2.1 Development of Training Material During Design Phase

The training department and subject matter experts work together to create course material and recommend the method of instruction. Course content including lesson plans, briefing guides, handouts, exercises and exams is based on course objectives developed by line management, subject matter experts, and the training department. Trainee mastery will be evaluated by various methods, including administering written tests, or by management observation of trainee's demonstration of skills and knowledge during actual job performance.

12.4.2.2 Development of Training Material During Facility Construction

The construction organization uses subject matter experts to create course material and recommend the method of instruction. Course content including (as applicable) lesson plans, briefing guides, handouts, exercises and exams is based on course objectives developed by line management and subject matter experts. Trainee mastery is evaluated by various methods, including administering written tests, or demonstration of skills and knowledge presented in the classroom.

12.4.2.3 Development of Training Material During Facility Operations

The WTP's performance-based training system will provide a systematic approach for the development, conduct, and evaluation of training programs. Performance-based training will include five general phases: analysis, design, development, implementation, and evaluation. These five training system phases will be implemented on a graded approach governed by facility procedures. At a minimum, the full five phase performance-based system will be applied to positions where the SAR specifies human performance as necessary to prevent or mitigate consequences of SAR concerns. Using this systematic approach to training will ensure the facility training system achieves the following:

- Bases training on a systematic analysis of each job position - The training staff and technical experts will develop a list of tasks that require training by using available job information such as safety and hazards analyses procedures, TSRs, and equipment and system operating manuals.
- Uses learning objectives derived from the analysis - Learning objectives will be defined during the design phase of the systematic approach to training. Action statements that describe the desired post-training performance by using the task list will be developed. Learning objectives will identify the knowledge, skills, and abilities the trainee must demonstrate, the conditions under which required actions will take place, and the standards of performance the trainee will achieve. Learning objectives are sequenced based on their relationship to one another.

- Evaluates trainee mastery of objectives during training - Trainee mastery will be evaluated by administering oral or written tests (or both) at the end of most courses, and by measuring student behavior in terms of the skills, knowledge, and attitudes exhibited in the operational environment, utilizing job performance measures.
- Bases evaluation and revisions on the job performance of trainees - Through ongoing performance monitoring, and by observing facility events, reviewing industrial accident reports, and interviewing personnel, tasks will be identified in which inadequate training may be contributing to equipment damage, unscheduled maintenance, unsafe practices, or non-adherence to approved procedures.

Personnel knowledgeable of the training design and process functions will use the information obtained in the analysis and design phases to develop training materials that accomplish the learning objectives. Each job task selected for training from the facility-specific list of tasks is linked to supporting procedures and training materials. Training materials may include lesson plans, student guides, handouts, software, and written, oral, or performance evaluations. Lesson plans or equivalent training guides will be developed to provide guidance and ensure consistent presentation of in-class training and OJT.

Lesson plans will typically include the following elements:

- Learning objectives
- Instructor preparation guidelines
- A list of the training aids and materials used in the lesson
- Safety precautions and procedural limitations
- References
- A list of prerequisite training
- Presentation methods
- Evaluation methods.

WTP procedures describe the process for review, approval, and revision of training materials.

Examinations (e.g., oral, written, performance) will be prepared during the development phase to provide a means to objectively assess student mastery of the material. Examination design will include a review of the test item data from the design phase, a comparison of the learning objectives and test items as stated in the lesson plan, and development of a test specification table to ensure the student has met the learning objectives in terms of knowledge, comprehension, and application.

12.4.3 Maintenance of Training

During all project phases, personnel whose job tasks will be affected by a change in an administrative process or procedure, or by an SSC being modified, will be trained on the changes prior to performance of the job tasks.

12.4.3.1 Maintenance of Design and Construction Phases Training

Effective training programs reflect current Project policies, procedures, configuration, and current regulations. To ensure training properly reflects the current situation, a process to maintain WTP training materials current tracks items that may affect the content of training programs and materials, including the job tasks analysis for the positions affected by the changes. The training department and line management respond to feedback from the configuration management system, quality program, and self assessment activities regarding physical, technical, and procedural changes to the project. New regulations, the need for performance improvements, or a reorganization of job responsibilities are other examples of changes that must be evaluated for impact on the training and development program. Training will be modified or developed in a timely manner and as appropriate to respond to sources of feedback, changing requirements, or changing policy or procedures.

Systematic evaluations of the training and development program are performed to measure training adequacy and its relationship to on-the-job performance. In addition, student course critique results are used for on-going adjustments to the course content and presentation.

12.4.3.2 Maintenance of Operational Phase Training

To ensure that training reflects current operating practices and procedures, a process to maintain training materials current will track items that may affect the content of WTP facility training programs and materials. This process will be accomplished in conjunction with the configuration management program (section 17.4.2, Configuration Management) and the procedure change process, and will permit the training staff to respond to the need for changes resulting from new or revised regulatory requirements, safety analyses, TSRs, procedure changes, changes in facility equipment configuration, and resolution of audit finding. The content of training materials will be revised using the same administrative controls that are used to develop new training materials.

Training and qualification programs require a significant investment in equipment, materials, and personnel resources. Periodic systematic program evaluations will be conducted to measure the training system's effectiveness in producing qualified employees. Training program evaluations can identify program strengths and weaknesses, determine if worker performance has improved, assess if program content matches current job needs, and determine if corrective actions are needed to improve program effectiveness. It will be a line management responsibility to lead training program evaluations and to implement corrective actions to make identified improvements. Program evaluations will be conducted on an established schedule and may consist of an overall evaluation or a series of topical evaluations over a period of time.

Evaluation objectives that are applicable to the training program or topical area being reviewed will be developed, and may address the following elements of training:

- Management and administration of training and qualification programs
- Development and qualification of training staff
- Trainee entry-level requirements
- Determination of training program content
- Design and development of training programs
- Conduct of training
- Trainee examinations and evaluations
- Training program assessments and evaluations by former trainees and their supervision

Evaluation results will be documented. Identified deficiencies will be reviewed, improvements recommended, and changes made to procedures, practices, or training materials, as necessary.

Auditable records will be maintained through the WTP facility Document Control System on individual employee training completions, job performance, and fitness for intended duty. These records will also include training documentation for subcontractor employees that work at the facility. Records of training development and evaluations will be maintained in training program files. Information such as courses completed, training expiration dates, and summary reports will be available to management to facilitate training analysis, planning, and scheduling activities. Record keeping requirements are described in more detail in section 17.4.4, Document Control and Records Management.

12.4.4 Modification of Operational Phase Training Material

The need to modify training materials may be identified as part of the periodic review process, as a result of an identified training deficiency, by operational event analysis, or by industry experience analysis. Programs will be developed to ensure needed changes identified from these sources are tracked and implemented.

Changes to training program content, together with the reason for the changes, will be documented in the facility training files.

12.5 References

WTP Project Documents

24590-WTP-ISMP-ESH-01-001-01, *Integrated Safety Management Plan*

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document, Volume II*

Codes and Standards

DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, US Department of Energy, Washington, DC, USA.

DOE Order 5480.20A, *Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Facilities*, US Department of Energy, Washington, DC, USA.

Figure 12-1 Document Type Hierarchy

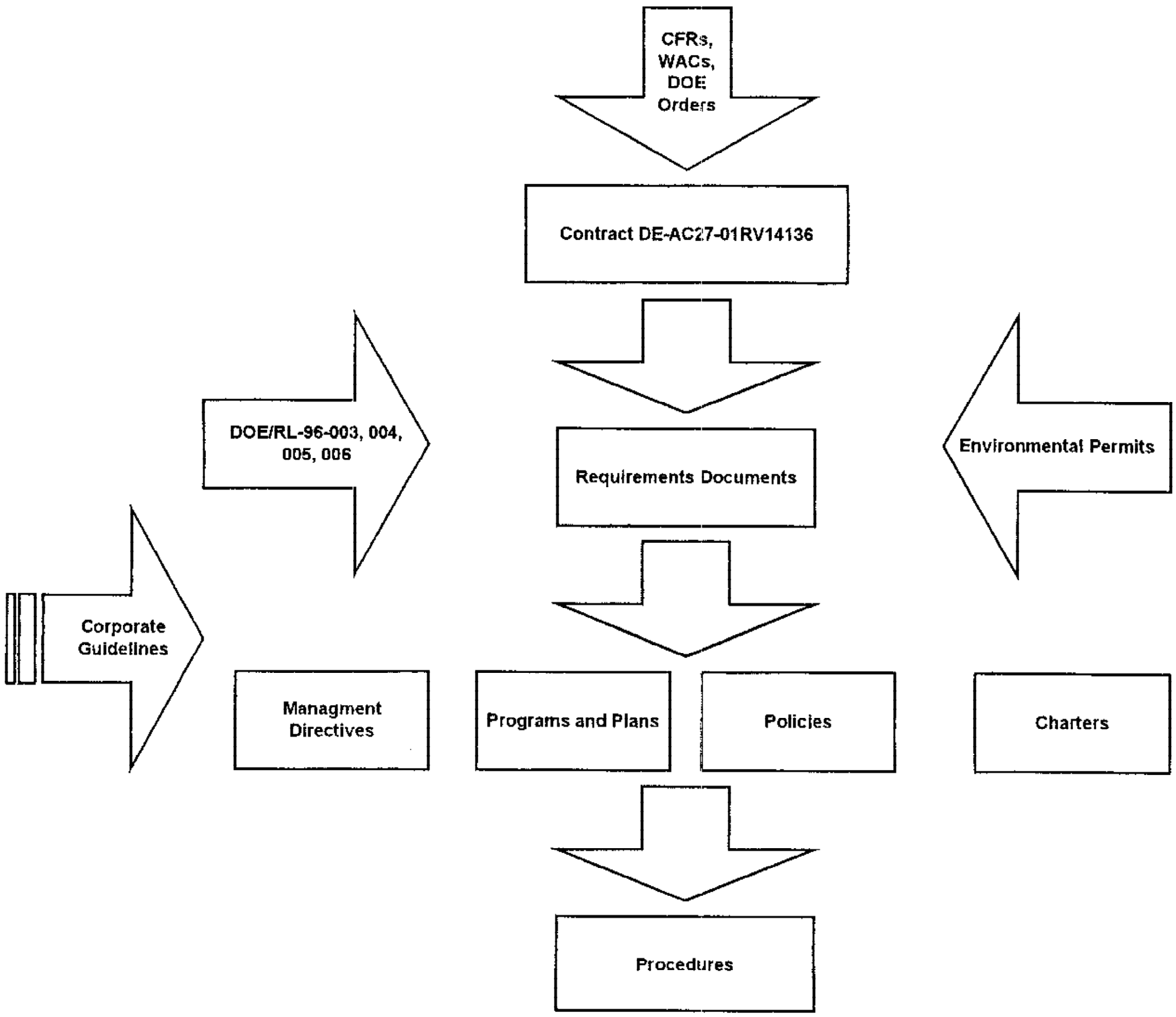
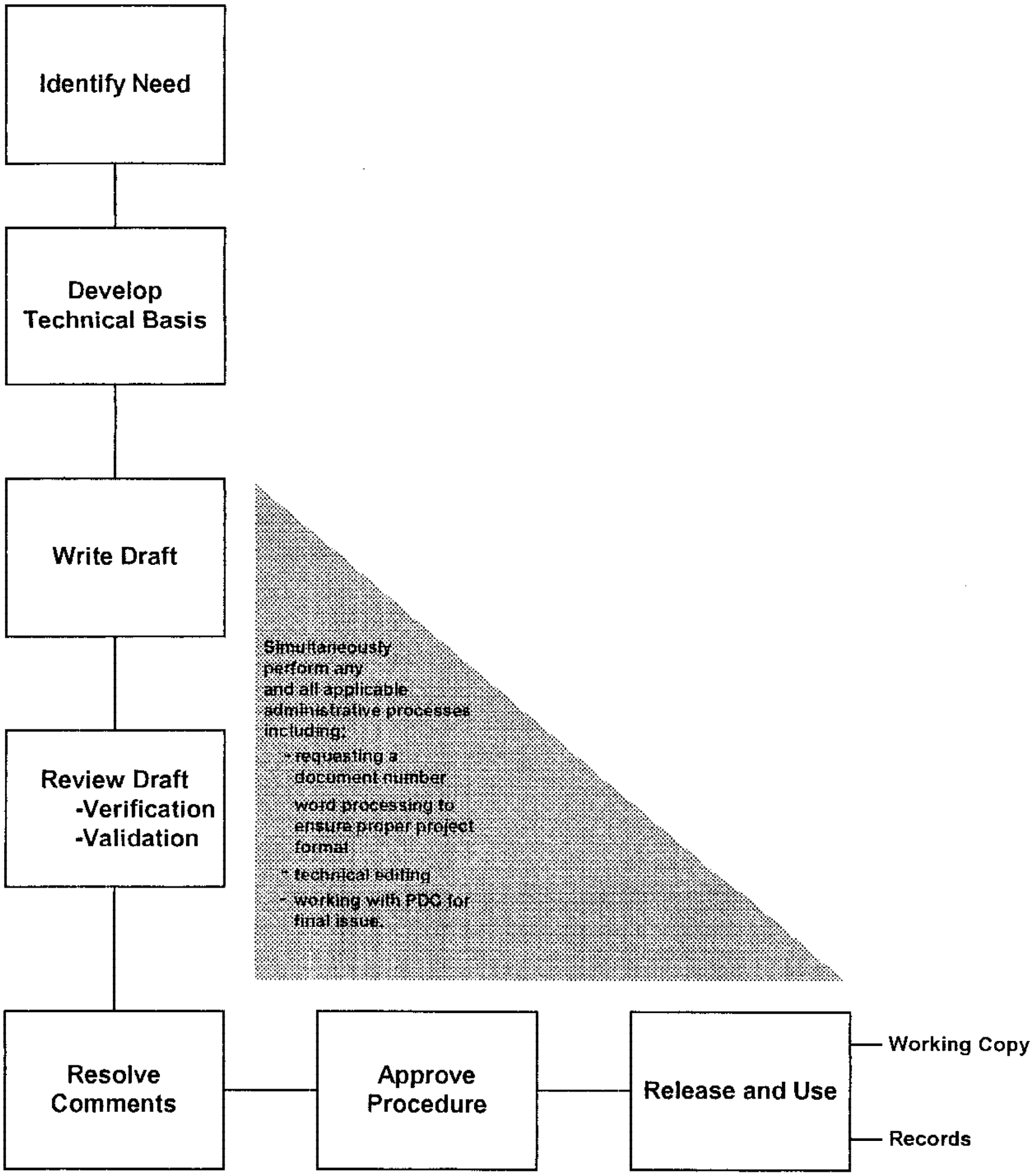


Figure 12-2 Procedure Development Process



14 Quality Assurance

Contents

14 Quality Assurance

14.1 Introduction

The *Quality Assurance Manual* (QAM) (24590-WTP-QAM-QA-01-001) establishes the quality assurance requirements for the River Protection Project - Waste Treatment Plant (WTP). The QAM meets the requirements specified below.

14.2 Requirements

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Chapter 1.0	Radiological, Nuclear and Process Safety Objectives	Safety Criterion 1.0-10
Section 7.3	Quality Assurance Program	Safety Criteria 7.3-1 through 7.3-12

10 CFR 830, Subpart A, *Quality Assurance Requirements*

ASME NQA-1-1989 (NQA-1), *Quality Assurance Program Requirements for Nuclear Facilities*

DOE Order 414.1A, *Quality Assurance*

DOE/RW-0333P (Rev. 10), *Quality Assurance Requirements and Description* (QARD)

14.3 References

WTP Project Documents

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan*

24590-WTP-QAM-QA-01-001, *Quality Assurance Manual*

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document, Volume II*

16 Deactivation and Decommissioning

Contents

16 Deactivation and Decommissioning

16.1 Introduction

This chapter describes the provisions that facilitate future deactivation and decommissioning (D&D) for the WTP. D&D discussions contained within this chapter will include current and future design and operational features, transitioning activities, relevant features of the *WTP Deactivation Plan* (PL-W375-G00003), and other features and procedures that simplify and facilitate D&D. It will include minimization of contaminated equipment and the generation of hazardous materials such as, radioactive or non-radioactive hazardous materials.

16.2 Requirements

SRD

Chapter 8.0 *Deactivation and Decommissioning* Safety Criterion 8.0-2

ISMP

Not addressed in the ISMP. The draft WTP deactivation plan was conditionally accepted on March 17, 2003 and the WTP Project commitments for deactivation were superseded by the commitments in this draft plan. (These commitments may be further revised in the final plan, and are not part of the authorization basis. However, the conditions of acceptance must be met.)

DOE O 430.1A, *Life Cycle Asset Management*

WAC 173-303, *Regulations for Implementing Procedural Provisions of the National Environmental Policy Act*

16.3 Design and Operational Features

The design and operational features for the WTP are developed to facilitate future D&D activities, including deactivation prior to D&D. This section discusses relevant features that will minimize the potential for spread of contamination that would complicate or reduce effectiveness of D&D activities.

16.3.1 Contamination Control

Systems containing hazardous material will be provided with suitable isolation provisions to prevent diffusion, backflow, or other methods of leakage of the contents to areas where the material is not intended. Areas within the WTP will be assessed and classified based on the potential for contamination, as well as the anticipated contamination levels. Contamination classifications of areas (such as, R1, R2, R3) will be defined in project implementing procedures.

Appropriate ventilation systems will be provided to minimize the spread of contamination. Systems will be based on the cascade principle with the direction of airflow from areas of low or no contamination (C1) to areas of higher potential contamination (C5). The complexity of ventilation systems and the need for filtration will be based on the potential for contamination.

The design of the WTP will facilitate the implementation of good housekeeping practices and anticipated decontamination methods that will prevent the accumulation and spread of hazardous material. Air monitors will be incorporated into the design to warn of airborne contamination.

16.3.2 Sampling

Throughout the WTP, material will be sampled for a number of purposes. The frequency of these samples will depend on the requirement for the sample. The WTP will be required to sample to support D&D activities. The details of the WTP sampling requirements relative to D&D will be described in the deactivation plan implementing procedures.

16.3.3 Architectural

Architectural material and product selection will minimize the quantity of hazardous waste generated during D&D activities. Interior finishes in areas of potential contamination will be non-porous for ease of decontamination.

16.3.4 WTP Process Facilities

The WTP process facilities will be a series of process unit operations located in controlled process areas and the layout designs will minimize the potential for the spread of contamination and facilitate D&D requirements. Specific design details of the WTP process facilities are contained in Chapter 2 of the facility specific information volumes of this document.

16.3.4.1 Special Requirements

The nature of the high radiation or potentially contaminated environment typical within process units has led to the development of minimum maintenance design principles that will allow for potentially zero contamination of the external surfaces of primary confinements and therefore the deactivation requirements will be limited to flushing interior surfaces. These principles are described in the *Basis of Design*, section 11.4, and are to be included in future volumes of the PSAR.

16.3.5 D&D Minimization Features

During the design phase of the WTP, a substantial and important element of the design process is the incorporation of features to minimize D&D activities. The WTP design process, including engineering review, considered and used D&D methodologies and mechanisms based on proven experience. The design of the WTP considered the following as described in the Deactivation Plan:

- Control of airborne contamination, radioactive particulate, mist, fumes and gases that may be released as a result of D&D.
- Removal or control of fixed contamination – radioactive materials ingrained into the interior of surfaces or structures, equipment, or other items.
- Identification, minimization, and disposal methods for high-level radioactive waste, TRU waste, mixed waste, hazardous waste, and low-level waste.
- Identification, minimization, and disposal routed for mixed waste.

- Suitable nonpermeable surface finishes (where practicable) will be provided for both equipment and buildings to ease the decontamination process. Stainless steel cell or cave liners will be used where appropriate and extended up walls as required by design or regulatory requirements. The walls above liners will be sealed with suitable finishes.
- In-cell washdown facilities will be provided to aid in D&D.
- Exhaust filtration equipment, where practical, will be located at or near individual enclosures to minimize long runs of ventilation ducting.
- Piping carrying contaminated (or potentially contaminated) liquids will be designed so as to be capable of being fully drained. Physical provisions will be made for cleaning and draining of equipment, vessels, and associated piping.
- Construction materials will be resistant to radiation, process solutions, and decontamination agents. Equipment and facilities will be constructed from materials amenable to volume reduction and eventual disposal.
- The layouts will minimize "dead" spaces (nooks and crannies) where contamination could build up and be difficult to remove
- Hoisting equipment, adequate headroom and clearances designed into the facility for operations will be used to aid D&D
- Appropriate in-cell penetrations will be provided to aid D&D where justified.

16.4 Deactivation Requirements

The following facility deactivation activities are those pertinent to deactivate a facility as complex and extensive as the WTP. The Deactivation Plan will discuss steps similar to the following and should identify the schedule of activities.

16.4.1 Administrative

The BNI responsibility to design, construct, and commission WTP will consider these elements for some future deactivation activity.

- Policy and Operational Issues – These issues are identified to ensure the deactivation tasks can be planned and executed as effectively as possible. Policy issues would include organizational responsibilities, future uses of the facility, immediate demolition in place of deactivation, and so forth. Operational issues would include identifying appropriate personnel, heating, ventilation, and other services after deactivation, and continued elimination or mitigation of hazards.
- Define Deactivation Overall End State –_Note: The term facility deactivation overall endpoint refers to the set of conditions that compose the completion of facility deactivation (that is, radiological, structural, equipment, and documentation). Deactivation facility overall endpoint, objectives, and requirements will be determined before deactivation, with confirmation that all deactivation objectives and requirements have been identified. This step will also include identifying all elements of the Deactivation Project Management Plan.
- Determine Project Scope – Determine the facilities to be included in the deactivation including office spaces, process facilities, and infrastructure.
- Integrate Safety Into the WTP D&D:

  - Ensure safety standards and requirements are in place, including occupational/industrial, chemical and radiological. An integrated safety management system will be used. Worker health and safety will be one of the goals of the project during deactivation.
  - The scope of the hazards will be identified using preliminary hazards analysis, commensurate with the adequacy of existing safety documentation, the extent of the hazards and the nature of the work to be performed. This will include all aspects of radiological, nuclear, and process safety.
  - Ensure the authorization basis documentation is appropriate for the deactivation stage. The safety Authorization Basis will be modified to reflect the conditions and safety requirements of the facility during D&D.

- Develop Endpoint Criteria and Endpoints – Develop and agree on endpoint criteria and endpoints in collaboration with DOE and regulatory agencies. These will include equipment and requirements for post-deactivation activities. All endpoints will be measurable, explicit, and verifiable. In addition, post-deactivation requirements, including surveillance and maintenance (S&M) will be defined.
- Identify and Evaluate Alternatives – Identify, assess, and evaluate alternatives and endpoints for deactivation activities.
- Prepare Baselines – Prepare a performance baseline, cost, and schedule baseline, technical baseline, and milestones.
- Issue Project Plan –Prepare a S&M plan at this time. Include activities required to identify the radiological controls, maintain the operability of critical equipment and activities required to maintain the structural integrity of the deactivated facility.

16.4.2 Work Requirements

- Prepare Detailed Work Packages – This should include such items as: describing work scope activities, identifying work procedures, preparing work permits, training, personal protective equipment, and engineering studies. A safety review will be conducted to evaluate the work packages against the safety Authorization Basis for D&D.
- Project Execution – After the work packages have been developed, the work will be performed until all agreed endpoint conditions have been achieved and verified. Waste generated during the performance of deactivation activities should be consistent with waste minimization and regulatory requirements.
- Feedback – As tasks are performed, a feedback mechanism should be used to provide information on unforeseen hazards and to develop corrective actions to mitigate any hazards and develop new controls.

16.4.3 Project Closure

- Endpoint Closeout – Verify the achievement of the agreed endpoint conditions. A record of the verification method used will be included in the project closeout documentation.
- Final Report – Prepare a turnover package that will consist of various deactivation approvals, reports, verifications, and post-deactivation S&M requirements. The report will include the following:
  - Project Background
  - Project Performance

- Project Management
- Project Safety and Health Management
- Configuration Documentation
- Lessons Learned

In addition, a separate S&M plan will be written and submitted to the DOE for approval. Approval must be obtained before deactivation can be considered complete.

Detailed criteria and objectives for the preceding requirements are contained in the Deactivation Plan.

16.5 Transition Readiness

Before commencing deactivation, the WTP contractor will perform a review of the deactivation tasks to determine what, if any, facility transition readiness assessment or review is required. Transition is described as activities that occur between operations and disposition in the WTP's life cycle. Disposition consists of three phases: 1) deactivation, 2) decommissioning, and 3) long-term S&M. Following the readiness preparations, DOE approval to initiate deactivation will be requested.

16.5.1 Transition Readiness Review

The following subjects are examples that will be evaluated and the results incorporated in the D&D transition readiness assessment and review report.

- Authorization Basis documentation
- Operating and maintenance procedures
- Controls for maintenance work
- Configuration control documentation
- Explicit delineation of the physical boundaries of the facilities and physical structures included
- Characterization baseline survey to determine the nature, level, and probable extent of contamination
- Listing of types and quantities of nuclear and fissionable materials
- Inventory and estimate of existing toxic, hazardous, and radioactive materials
- List of permits, licenses, and agreements that have been terminated or remain imposed on the facility
- List of outstanding commitments to the DOE, regulatory authorities, and stakeholders that require action
- Human resource requirements and availability for deactivation

16.6 Turning Over WTP Facilities to DOE

The process and protocols for transfer of the WTP facilities to DOE will be consistent with DOE G-430.1-5, *Transition Implementation Guide,* and include the following:

- DOE and an authorized third party should review the facility deactivation status as described in the endpoint completion report and agree that all deactivation endpoints have been successfully achieved.

It is anticipated that DOE and the third party will approve and endorse each endpoint completion as it occurs and that final review of the endpoint completion report will be for administrative closure only.

- A transfer documentation package comprising administrative, technical, and post-deactivation operations and maintenance documents will be issued to DOE. In support of records turnover, as required, only the latest revision of applicable documents will be provided as endpoint deliverables. Record or documentation turnover to DOE will be accomplished using electronic media wherever possible versus hard copy. It is anticipated that DOE will endorse each document as it is issued and approved.
- DOE will be informed 30 days before completion of all deactivation activities for the WTP facilities. Subsequent to DOE review and acceptance of the WTP turnover documentation and deactivation endpoint status, DOE will endorse the ownership transfer documentation and accept ownership of the WTP facilities. Turnover of the WTP facilities to DOE will be completed within 30 days of deactivation completion.
- The WTP contractor will agree to a schedule for modifying and turning over to DOE the WTP Authorization Basis, which will reflect the deactivated status of the facilities. DOE will have approved the Authorization Basis.
- At the completion of deactivation, DOE will allow modifications that reflect the facilities change of status and remove the WTP Contractor from any continuing dangerous waste and air permits.

16.7 References

DB-W375-EG00001, *Basis of Design*

DOE G 430.1-2, *Implementation Guide For Surveillance and Maintenance during Facility Transition and Disposition*

DOE G 430.1-3, *Deactivation Implementation Guide*

DOE G 430.1-4, *Decommissioning Implementation Guide*

DOE G 430.1-5, *Transition Implementation Guide*

PL-W375-G00003, *Deactivation Plan*

17 Management, Organization, and Institutional Safety Provisions

Contents

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17 Management, Organization, and Institutional Safety Provisions

17.1 Introduction

Bechtel National, Inc. (BNI) is the design, construction, and commissioning (DC&C) contractor of the Hanford Tank Waste Treatment and Immobilization Plant (WTP) Project. The WTP operations contractor and the deactivation contractor selections will be made at a future date.

The BNI organization for the WTP Project will accomplish its defined work in a contractural and regulatory compliant manner that provides for the health and safety of workers and the public and protects the environment from degradation.

The WTP Project organization key activities related to safety and their schedules, including regulatory interface actions with the DOE Office of River Protection, Safety Regulation Division (OSR), roles and responsibilities, interface management, and safety management controls are presented in this chapter for the DC&C phase of theWTP Project.

17.2 Requirements

Safety Requirements Document (SRD; 24590-WTP-SRD-ESH-01-001-02)

Chapter 1.0	Radiological, Nuclear and Process Safety Objectives	Safety Criteria 1.0-1, 1.0-9
Chapter 4.0	Engineering and Design	Safety Criteria 4.0-1, 4.0-2, 4.0-3
Chapter 7.0	Management and Operations	Safety Criteria 7.0-3, 7.0-4
Section 7.1	Management and Organization/Staffing	Safety Criterion 7.1-3
Section 7.3	Quality Assurance Program	Safety Criteria 7.3-8, 7.3-9
Section 7.4	Unreviewed Safety Question	Safety Criteria 7.4-1 through 7.4-5
Section 7.7	Reporting and Incident Investigations	Safety Criteria 7.7-1 through 7.7-8
Section 9.1	Safety Analysis Reports	Safety Criterion 9.1-5

Integrated Safety Management Plan (ISMP; 24590-WTP-ISMP-ESH-01-001)

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 17
1.3	Scope and Safety Documentation Related to Limited Construction	17.4.4, "Submittal of Regulatory Safety Related Documentation."
1.3	Scope and Safety Documentation Related to Partial Construction	17.4.4, "Submittal of Regulatory Safety Related Documentation."
1.3	Scope and Safety Documentation	17.4.4, "Submittal of Regulatory Safety Related

ISMP Section	WTP Project Integrated Safety Management Element Related to Construction	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 17 Documentation.
1.4	Development of Safety Management Processes	17.6.1, "Project Integrated Safety Management Approach."
1.4	Identification of Safety Management Program Drivers	17.6.1, "Project Integrated Safety Management Approach"
1.4	Development of Safety Management Programs	17.6.1, "Project Integrated Safety Management Approach"
1.5	Compliance with and implementation of 10 CFR 830	17.4.1, "Documentation for Compliance with 10 CFR 830, 'Nuclear Safety Management"
1.5	Compliance with and implementation of 10 CFR 835	17.4.2 , "Documentation for Compliance with 10 CFR 835, 'Occupational Radiation Protection'"
1.5	Radiation Protection Program	17.4.2, "Documentation for Compliance with 10 CFR 835, 'Occupational Radiation Protection'"
1.5	Compliance with 10 CFR 820, "Procedural Rules for DOE Nuclear Facilities"	17.4.3, "Documentation for Compliance with 10 CFR 820, 'Procedural Rules for DOE Nuclear Activities"
1.5	Statutory Compliance	17.5.3.1, "External Interfaces," subsection Regulatory Interfaces
1.5	Training and Qualification	17.5.4, "Staffing and Qualification"
1.5	Personnel Qualifications and Resources	17.5.4, "Staffing and Qualification"
1.5	Development of the Operator Training Program	17.5.4, "Staffing and Qualification"
1.5	Project Integrated Safety Management Approach	17.6.1, "Project Integrated Safety Management Approach"
1.5	Laws/Regulations/Top-Level Safety Requirements/Best Industry Practices	17.6.1, "Project Integrated Safety Management Approach"
1.5	Identification of Safety Requirements	17.6.1.1, "Identification of Work, Hazards, Controls, and Standards"
1.5	Control of the AB	17.6.3, "Configuration Management."
1.5	Configuration Management	17.6.3, "Configuration Management"
1.5	Document Control and Maintenance	17.6.4, "Document Control and Records Management"
1.5	Content of AB	17.6.5, "Authorization Basis Management"
1.5	Changes to the AB	17.6.5, "Authorization Basis Management."

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 17
1.5	Unreviewed Safety Questions	17.6.6, "Unreviewed Safety Question Process"
1.5	Incident Investigations	17.6.7, "Occurrence Reporting"
1.5	Safety Improvement	17.6.2.1, "PSC Safety Oversight"
1.5	Safety/Quality Culture	17.6.8, "Safety/Quality Culture"
1.6	Environmental Protection Interface	17.5.3.1, "External Interfaces"
1.6	Occupational Health and Safety Interface	17.5.3.1, "External Interfaces"
1.6	Safeguards and Security Interface	17.5.3.1, "External Interfaces"
1.6	DOE Inspection Program	17.5.3.1, "External Interfaces"
1.6	DOE Corrective Action/Enforcement Action Program	17.5.3.1, "External Interfaces,"
1.7	Scheduling Safety-Related Activities	17.3, "Key Activities Related to Safety" and Section 17.4.4, "Submittal of Regulatory Safety Related Documentation." PSAR Vol. I Tables 17-1 through 17-3.
1.7	Scheduling of Events for Regulatory Submittals	17.4.4, "Submittal of Regulatory Safety Related Documentation"
1.8	Compliance Audits	17.6.2, "Safety Review and Performance Assessments"
1.8	Internal Safety Oversight	17.6.2 "Safety Review and Performance Assessments"
1.8	Safety Committees	17.6.2, "Safety Review and Performance Assessment"
1.8	Performance Monitoring	17.6.2.2, "Management Assessments and Independent Assessments of the WTP Project"
1.8	Performance Indicators	17.6.2.2, "Management Assessments and Independent Assessments of the WTP Project"
1.8	Assessments	17.6.2.2, "Management Assessments and Independent Assessments for the WTP Project"
1.8	Management Assessments	17.6.2.2, "Management Assessments and Independent Assessments for the WTP Project"
1.8	Independent Assessments	17.6.2.2, "Management Assessments and Independent Assessments for the WTP Project," Audits."
1.8	Lessons Learned	17.6.7.8, "Lessons Learned" and Section 17.6.7,

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 17
		"Occurrence Reporting"
1.8	Feedback and Trending	17.6.7.9, "Feedback and Trending."
1.9	Content of AB	17.4.5, "Tailoring of Regulatory Safety Related Documents" and Section 17.6.5, "Authorization Basis Management"
1.9	Tailoring of Documentation Related to Safety	17.4.5, "Tailoring of Safety-Related Documentation."
1.10	Safety Responsibilities	17.5.2, "Organizational Responsibilities"
1.10	Design, Construction, and Commissioning Contractor Organization Roles, Responsibilities, and Authorities	17.5.2.1, "Design, Construction, and Commissioning Contractor Roles and Responsibilities"

17.3 Key Activities Related to Safety

Key activities related to safety are those higher-level activities that are integral to the preservation of the WTP Authorization Basis (AB) for protecting worker and public health and the environment. Tables 17-1 to 17-3 show these activities, in a project life-cycle phased flow sequence, together with the assignment for the conduct of these activities to Project functional areas.

17.4 Regulatory Safety Related Documentation

Regulatory safety deliverables associated with approvals for start of construction and commissioning include the safety documentation necessary to support WTP Project authorizations. These regulatory safety documentation deliverables and the subordinate tasks to prepare, review, and approve them are reflected in formal Project plans and schedules developed as part of project execution and control activities.

The scope of WTP construction and commissioning safety-related documentation deliverables and schedules is as described in the amended WTP design, construction, and commissioning Contract. Safety documentation for construction and commissioning is submitted in compliance with this WTP Project contract, Section C, Standard 7. This Standard, in particular Table S7-1, defines the flow and schedule of Contractor important-to-safety documentation deliverables.

17.4.1 Documentation for Compliance with 10 CFR 830, "Nuclear Safety Management"

The WTP Project develops, implements, and maintains its nuclear safety management program in compliance with 10 CFR Part 830, "Nuclear Safety Management". This program complies with the requirements for 1) a Quality Assurance (QA) program, as specified in 10 CFR 830, Subpart A, "Quality Assurance Requirements" and 2) with the development, implementation, and maintenance of the WTP nuclear safety basis documentation as specified in 10 CFR 830, Subpart B, "Safety Basis Requirements".

The Project QA program is implemented to ensure that the design, procurement, construction, testing, inspection, operation, maintenance, and deactivation activities conform to regulatory and contractual requirements. The QA Program is structured to reflect BNI Corporate QA program policy, as well as use of NQA-1-1989; *Quality Assurance Requirements for Nuclear Facility Applications*, DOE/RW-0333P, *Quality Assurance Requirements and Description (QARD) for the Civilian Radioactive Waste Management Program*; and DOE Order 414.1A, *Quality Assurance*. The QA Program document is issued as the RPP-WTP Project Quality Assurance Manual (QAM). This QAM, which supports compliance with 10 CFR 830 Subpart A, serves as the Authorization Basis document for implementation of the WTP Project QA Program.

The Safety Analysis Reports (SARs) for the WTP serve as the documented safety analysis (DSA) required by 10 CFR 830 Subpart B. The SARs furnish the safety analysis documentation for the facility to demonstrate that the WTP can be safely operated, maintained, and shut down. The Initial Safety Analysis Report (ISAR) was developed during conceptual design of the facility. Those portions of the ISAR that relate to the fundamental aspects of design were considered to be part of the AB. The Preliminary Safety Analysis Report (PSAR) is based on the facility design and plans for construction authorization and demonstrates adequate planning for the operational phase. The Final Safety Analysis Report (FSAR) documents the completed design and construction and provides details on the plans for operation. The FSAR includes facility and process drawings and fabrication and construction specifications important to the safety analysis of the facility. Other safety basis documentation required by 10 CFR 830 Subpart B to support operations (e.g., Technical Safety Requirements, Unreviewed Safety Question process procedure) will be provided for DOE approval prior to the beginning of WTP hot commissioning.

17.4.2 Documentation for Compliance with 10 CFR 835, "Occupational Radiation Protection"

A radiological control program that implements the requirements of 10 CFR 835 and additional requirements specified in SRD Volume II Chapter 5.0 "Radiation Protection" is established for the WTP Project. Documentation for compliance with 10 CFR 835, "Occupational Radiation Protection" is presented in 24590-WTP-RPP-ESH-01-001, *Radiation Protection Program for Design and Construction.*

17.4.3 Documentation for Compliance with 10 CFR 820, "Procedural Rules for DOE Nuclear Activities"

The Contractor complies with the 10 CFR 820 procedural rules to meet Price Anderson Amendments Act (PAAA) nuclear safety requirements through the development of the necessary procedures and processes to implement the related nuclear safety programmatic requirements (e.g., the Quality Assurance Manual, Safety Analysis Reports, Radiation Protection Program for Design and Construction, Employee Concerns Program, and PAAA noncompliance reporting). The processes for meeting PAAA requirements also include the appropriate procedures and systems to perform audits and self-assessments, identify potential PAAA noncompliances, perform root cause analysis, track and trend noncompliances, and track the implementation of corrective actions.

17.4.4 Submittal of Regulatory Safety Related Documentation

The sequence of submittal of authorization requests includes the following safety related documentation. This documentation includes Project defined requests as well as those deliverables required by

DOE/RL-96-0003, *DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor.*

1) A Limited Construction Authorization Request (LCAR) for early initiation of construction activities that addresses preliminary site preparation, excavation, installation of the mud mat, information on site suitability; stability of surface soils; design requirements, Quality Assurance (QA) program to be applied; current SRD standards; description of planned safety-related testing; procedures to be employed; and the environmental impacts of implementing the requested work activity. DOE approval of the LCAR results in limited construction authorization. The LCAR document serves as AB safety documentation during limited construction authorization activities.
2) A Partial Construction Authorization Request (PCAR) that includes portions of the Preliminary Safety Analysis Report (PSAR). PCARs are used to request DOE authorization for the construction of selected WTP construction scope items, prior to receipt of full construction authorization. These PCAR submittals segment and incrementally submit the CAR to allow construction of the basemat and other facility elements below and up to grade. The information provided in a PCAR is consistent with the Contract requirement of contractor notification of intent to submit a segmented or incremental construction authorization request and with the information provided in the PSAR. The PCAR allows additional review time to support the phased PSAR approval to support full construction work authorization.
3) A full CAR package includes the Preliminary Safety Analysis Report (PSAR). The CAR addresses DOE/RL-96-0003, Section 4.3.2, "Contractor Input." Approval of the CAR initiates full construction.
4) An operating authorization request (OAR) package includes the Final Safety Analysis Report (FSAR). The OAR will address DOE/RL-96-0003, Section 4.4.2, "Contractor Input." The OAR will likely be submitted on a facility by facility basis.
5) Submittal of the deactivation authorization request (DAR) will be provided by the deactivation contractor. The DAR will address DOE/RL-96-0003, Section 4.6.2, "Contractor Input." This will likely include revision of the FSAR to provide additional detail on deactivation activities.

17.4.5 Tailoring of Regulatory Safety Related Documentation

Regulatory safety related documentation deliverables that address the Project integrated safety management approach are tailored commensurate with WTP hazards.

The following subsections describe how the SARs, the SRD, the Radiation Protection Program (RPP) document, the QAM, the Technical Safety Requirements (TSRs), and the emergency response plan are tailored to the reflect the hazards and hazardous situations of the WTP.

Safety Analysis Reports. The format and content of the Preliminary Safety Analysis Report (PSAR) and Final Safety Analysis Report (FSAR) are in accordance with *Safety Requirements Document Volume II*, SRD Vol. II Safety Criterion 9.1, "Safety Analysis Reports" and the implementing standards referenced in that safety criterion. To facilitate the review of the SARs by the regulator, the SAR content also gives consideration to the review guidance developed by DOE. For the PSAR this guidance is provided in *Review Guidance for the Construction Authorization Request (CAR)* (DOE-RL 2001).

The format and content of the SARs are tailored to the nature of the WTP, relative to the hazards and hazardous situations identified by the PHA.

The content of the PSAR and FSAR is tailored to the purpose of these two documents. The PSAR supports the request for the construction authorization by documenting the safety criteria, the principal design and construction requirements, and the initial safety analysis. The FSAR documents application of these criteria to the completed WTP, documents the final safety analysis, and establishes the facility can be operated safely. The PSAR places greater emphasis on design criteria and construction practices than conduct of operations. The FSAR places emphasis on conduct of operation.

Safety Requirements Document (SRD). The SRD, which reflects conformance to DOE/RL-96-0003, DOE/RL-96-0004, and DOE/RL-96-0006, is tailored to reflect adequate control of hazards and hazardous situations associated with WTP design, construction, commissioning, and operation. DOE/RL-96-0006 provides a set of top-level radiological, nuclear, and process safety standards and principles prescribed by DOE for accomplishing the required level of safety for the WTP and is used as one resource for the development of the SRD. Included in DOE/RL-96-0006 are radiological exposure and risk standards for evaluation of normal and off-normal events. Additional resources for the identification of standards in the SRD are derived from commercial nuclear and chemical industries. The tailoring activity for the SRD includes identifying those Safety Criteria that are to accomplish Project activities safely, and then applying the implementing codes and standards to these criteria based on the risks posed by the hazardous situations being controlled. Features controlling hazardous situations with the potential for greater impacts (such as an offsite release affecting the public) have more rigor applied to them than those features controlling hazardous situations with lower impacts.

Radiation Protection Program (RPP) document. The occupational RPP document details the program, standards, requirements, administrative controls, responsibilities, and authorities associated with the scope of WTP radiological protection activities. The RPP specifically documents the program required by 10 CFR 835, "Occupational Radiation Protection". The RPP document is tailored to focus on the protection of worker health and safety in response to the radiological hazards present during given phases in the WTP life cycle. The RPP document provides the regulatory technical basis for the RPP that ensures the radiological safety of facility workers, collocated workers, facility visitors, and the onsite, co-located members of the public.

Quality Assurance Manual. The QAM serves as the Authorization Basis document for implementation of the Project QA program. The QA Program, as described in the QAM, provides assurance that the design, procurement, construction, testing, inspection, operation, deactivation, waste form qualification, modification, and maintenance activities conducted at the facility conform to regulatory and contractual requirements and reflect best industry practices. The extent to which quality requirements are applied to the Project is based on a graded approach, reflecting the safety implications of the activity. Quality-related activities performed by organizations providing equipment, services, or support to the Project are conducted in accordance with the requirements documented in the approved QAM.

Technical Safety Requirements (TSRs). The TSRs will be based on the FSAR safety basis documentation and facility-specific commitments made to support the DOE-approved safety basis for the WTP. They will be tailored to focus on the protection of the public and worker health and safety from radiological, nuclear, and process hazards. The TSRs will be further tailored based on the following needs:

1) Designation of process variables, design features, and operating restrictions that are initial conditions (i.e., reflect the assumed facility state) for accident analysis-credited preferred control strategies to meet public and worker radiological or chemical exposure standards

2) Assurance that SSCs credited for achieving compliance to public and worker radiological and chemical exposure standards will function when required.

The TSRs will be kept current so that they reflect the facility as it exists and as is analyzed in the FSAR. The WTP will be operated to the DOE-approved TSRs.

As the WTP operation nears the end of waste-processing operations, changes will be initiated to the TSRs to control the hazards and hazardous situations associated with deactivation.

Emergency Response Plan (ERP) The WTP emergency response plan documents the provisions for response to operating emergencies. The emergency response plan will establish effective and efficient emergency management operations that provide acceptable levels of protection for WTP workers, Hanford Site employees, and the public. The scope of the WTP emergency management program, from which the emergency response plan is tailored, is determined by performing a Hazards Survey and Assessment for the facility.

The Hazards Survey briefly describes the potential impacts of emergency events or conditions and summarizes applicable federal, state, and local planning and preparedness requirements. The Hazards Survey identifies the required scope of the WTP emergency management program.

17.5 Organizational Structures, Responsibilities, and Interfaces

17.5.1 Organizational Structure

The philosophy of the organizational structure is determined by the need to ensure that safety is achieved while meeting DOE requirements in an efficient manner. The organizational structure presents the BNI approach to assigning responsibility for managing work safely and staffing the organization with suitably qualified and experienced personnel.

The WTP QAM Policy Q-01.1, Figure 1, Overall Management Structure and Organization, depicts the management structure and organization established by BNI for implementing the DC&C contract. The solid lines in the figure represent direct management and reporting responsibilities, whereas the dotted line from the Project Director to the Quality Assurance Manager and the Safety Assurance Manager represents an interface other than a direct reporting responsibility. The project QA Manager and the Safety Assurance Manager report directly to the BNI Corporate QA and Industrial Safety Managers respectively.

The flowdown of health, safety, and environmental responsibility and accountability starts with the Project Director and extends through the management and supervisory chain to each worker regardless of the type of work being performed. This flowdown is captured in policies, manuals, and procedures, communicated to the workforce through orientation and training, reinforced by group and individual performance evaluations, and monitored and assessed by management and by independent oversight organizations.

17.5.2 Organizational Responsibilities

The WTP Project Director has established a policy committing the project to designing, constructing, and commissioning the plant in such a manner as to ensure protection of the health and safety of the public, personnel on site, and the environment.

Accordingly, Contractor roles, responsibilities, and authorities include defining and implementing radiological, nuclear, and process safety (rnps) standards and the related safety bases for protection of the WTP workers, co-located workers, the public, and the environment. The Contractor has sole responsibility for defining and implementing ORP approved safety standards and communicating those safety standards as requirements to all project personnel and subcontractors who conduct work on the project.

Clear unambiguous lines of authority and responsibility are established throughout the Project through its design, contruction, and commissioning phases. The flowdown of safety management responsibility and accountability starts with the WTP Project Director and extends through the management and supervisory chain to each worker, irrespective of the type of work being performed. This flowdown is captured in policies and procedures, communicated to the workforce through orientation and training, reinforced by group and individual performance evaluations, and monitored and assessed by independent oversight provided by safety management professionals.

Line management is responsible for developing and implementing the safety basis. Although some specific roles may be reassigned within the organization, line management's responsibility for safety may not be delegated. The Environmental and Nuclear Safety (E&NS) organization identifies regulatory requirements that are appropriate for the project, provides guidance for their implementation, and conducts internal oversight activities to ensure institutional safety provisions are implemented. This creates an environment where accountability is clearly focused.

Stop-work authority flows down from senior management to individual workers who are empowered to halt any activity in which they are engaged that is unsafe or potentially harmful to workers, the public, the environment, facilities, or property. Project management is responsible for ensuring the safety of employees and subcontractors, for taking appropriate actions to correct causes for stopping work, and for authorizing the restart of work.

17.5.2.1 Design, Construction, and Commissioning Contractor Roles and Responsibilities

The WTP Project AB documents describe the roles, responsibilities, and authorities, including those related to safety, assigned to individuals and managers during the design, construction, and commissioning phases of the project. The QAM identifies overall WTP Project organization (Policy Q-01.1) and topic specific responsibilities. This section of the PSAR describes specific roles and responsibilities related to safety-related roles. Note: Throughout this chapter, reference to "safety" means radiological, nuclear, and process safety.

Fundamental roles, responsibilities, and authorities related to safety assigned to all WTP managers are:

- Incorporating the Integrated Safety Management System (ISMS) provisions into work processes.
- Developing and maintaining a comprehensive set of management controls.
- Interfacing and communicating with other project managers in accomplishing facility design, construction, and commissioning activities.

Fundamental roles, responsibilities, and authorities related to safety assigned to the Operations Manager include:

- Ensuring that operators become and remain familiar with the features and limitations of components included in the design of the facility.
- Ensuring that the design organization provides appropriate input for pre-operational testing, operating procedures, and the planning and conduct of training.

The BNI WTP Project contractor assigns safety roles to functional areas for key elements of the DC&C phases of the WTP project. The following provides a summary of these roles for project managers during the DC&C phases.

Project Director

The Project Director safety-related roles, responsibilities, and authorities include:

1) Overall responsibility for WTP project safety
2) Instilling a positive culture for safety
3) Defining safety policy, objectives, and interfaces
4) Reviewing at least annually, along with the Project Manager, the adequacy of project activities to comply with the WTP AB
5) Implementing an employee concerns program

Project Manager

The Project Manager safety-related roles, responsibilities, and authorities include:

1) Ensuring implementation of safety policy, objectives, and interfaces
2) Assigning roles and responsibilities for safety-related activities
3) Setting AB safety-related performance expectations
4) Developing and implementing management assessment policies
5) Reviewing at least annually, along with the Project Director, the adequacy of project activities to comply with the WTP AB expectations

Project Controls Manager

The roles, responsibilities, and authorities of the Project Controls Manager are provided in the WTP Project Quality Assurance Manual. There are no additional Project Controls Manager safety-related roles, responsibilities, and authorities to those roles provided in the Quality Assurance Manual.

Area Project Managers

This position is responsible for managing production of engineering design as the WTP Project design agency, and management support for subsequent construction and commissioning activities. The safety-related roles, responsibilities, and authorities of the Area Project Managers, in their respective WTP facility areas of responsibility, include:

1) Managing the production of safety-related engineering designs

2) Ensuring approval by the Manager of Engineering of final designs of Important to Safety features
3) Implementing safety-related management assessment policies.
4) Ensuring the development and implementation of the safety-related incident reporting program.
5) Developing and managing the readiness review program to support commissioning.

Manager of Engineering

The Manager of Engineering serves as the project design authority and oversees the engineering design activities that are assigned to the DC&C contractor, as implemented by the project areas design agency. The safety-related roles, responsibilities, and authorities of the Manager of Engineering include:

1) Ensuring that a safe WTP is designed in accordance with safety-related contractual, policy, law, regulations, authorization bases, and technical requirements
2) Approving final designs of Important to Safety features
3) Developing and implementing the Configuration Management (CM) program to control the safety and design bases
4) Serving as principal interface with DOE on engineering design technical issues
5) Overseeing activities related to radiological, nuclear, and process safety.

Construction Manager

The safety-related roles, responsibilities, and authorities of the Construction Manager include:

1) Ensuring that the WTP is constructed in safe manner, in accordance with safety-related contractual, policy, law, regulations, authorization bases, and technical requirements
2) Implementing procedures and training to enhance construction safety
3) Providing input to the configuration management program including as-built information
4) Supporting the incident reporting system for construction-related incidents
5) Interfacing with subcontractors on process safety management and E&NS matters
6) Implementing the construction testing program to verify that ITS SSCs meet acceptance testing requirements

Environmental and Nuclear Safety (E&NS) Manager

The safety-related roles, responsibilities, and authorities of the E&NS Manager include:

1) Developing and maintaining WTP Project AB documents (excluding the Quality Assurance Manual)
2) Providing support to ensure that the WTP is designed, constructed, and commissioned to meet safety-related laws, regulations, and AB requirements.
3) Developing and implementing safety management programs for nuclear safety, fire protection, and radiation protection
4) Developing and assessing safety-related performance measures
5) Interfacing with regulators, stakeholders, and Hanford Site contractors on safety-related matters

6) Serving as a member of the Project Safety Committee and serving as the PSC alternate chairperson

Safety Assurance Manager

The roles, responsibilities, and authorities of the Safety Assurance Manager are provided in the WTP Project Quality Assurance Manual. There are no unique Safety Assurance Manager safety-related roles, responsibilities, and authorities in addition to those roles provided in the Quality Assurance Manual.

Quality Assurance Manager

The roles, responsibilities, and authorities of the Quality Assurance Manager are provided in the WTP Project Quality Assurance Manual. There are no unique Quality Assurance Manager safety-related roles, responsibilities, and authorities in addition to those roles provided in the Quality Assurance Manual.

The QA Manager has the authority and responsibility to stop project work when the work, if allowed to continue, would result in activities or documents being in noncompliance with stated QA Program requirements. The QA Manager is responsible for determining when appropriate corrective or preventative actions have been taken and for lifting the stop work order to allow work to proceed.

Operations Manager

The safety-related roles, responsibilities, and authorities of the Operations Manager include:

1) Writing and maintaining operating procedures
2) Performing commissioning testing to demonstrate compliance with the acceptance criteria and documenting the results to acceptance criteria.
3) Serving as the chairperson for the Project Safety Committee
4) Developing and managing the readiness review program to support commissioning

Process Operations Manager

The safety-related roles, responsibilities, and authorities of the Process Operations Manager include:

1) Supporting independent safety review in the WTP Project process flowsheet areas of responsibility
2) Developing and evaluating proposed changes to the WTP process flowsheet

Research and Technology Manager

The safety-related roles, responsibilities, and authorities of the Research and Technology (R&T) Manager include:

1) Serving as a member of the Project Safety Committee.

Commissioning/Training Manager

The commissioning/training organization manages the commissioning program. The safety-related roles, responsibilities, and authorities of the Commissioning /Training Manager include:

1) Developing the objectives and scope for the startup program
2) Developing and evaluating proposed changes to the commissioning program
3) Verifying and validating operation and maintenance procedures during performance of testing
4) Providing information from the startup program to the operations, training, and procedures groups, and maintenance for verification and validation of operating administrative controls

Business Services Manager

The Business Services Manager safety-related roles, responsibilities, and authorities include:

The roles, responsibilities, and authorities of the Business Services Manager are provided in the WTP Project Quality Assurance Manual. There are no unique Business Services Manager safety-related roles, responsibilities, and authorities in addition to those roles provided in the Quality Assurance Manual.

Acquisition Services Manager

The safety-related roles, responsibilities, and authorities of the Acquisitions Services Manager include the roles, responsibilities, and authorities of the Acquisitions Services Manager are provided in the WTP Project Quality Assurance Manual. There are no unique Acquisitions Services Manager safety-related roles, responsibilities, and authorities in addition to those roles provided in the Quality Assurance Manual.

Project Archives and Document Control Manager

The safety-related roles, responsibilities, and authorities of the Project Archives and Document Control Manager include:

1) Controlling and maintaining the WTP Project safety-related policies and procedures
2) Developing and maintaining the records management program relative to WTP Project safety-related records

17.5.3 Interface Management Process

The interface management process assures the documentation and management of shared responsibilities among project-affected organizations for (1) services, data, or materials; and (2) development, operation, and maintenance of physically compatible facilities and subsystems.

17.5.3.1 External Interfaces

There are two types of external interfaces for the Project, technical interfaces and regulatory interfaces. This section describes the method of coordinating interface interaction and the process for resolving conflict.

Technical Interfaces - The technical interfaces are managed in accordance with an interface management plan supported by procedures and desk instructions, and documented in interface control documents (ICDs). ICDs detail the information needed to coordinate project activities safely and efficiently with Hanford Site operations. Primary interface management lies with the interface management team (IMT), composed of leadership members from CH2M Hill Group, Inc. (CHG), the WTP Contractor, i.e., BNI and DOE. ICDs are updated every six months throughout the period of the contract performance.

The nature of taking responsibility for transfer of Hanford Tank Farm waste to the WTP requires the resolution of a number of interface concerns. From an early stage, interface meetings were held among the WTP Contractor, the DOE, and the Hanford Tank Farms Contractor to identify and resolve these concerns. Interface responsibilities are agreed on and recorded in the ICDs. Adding concerns to this documentation and accepting their resolution requires approval of all parties involved with the interface issue. If a critical issue is not resolved in a timely manner, a mechanism is in place to elevate the issue for resolution by upper management of the interfacing organizations.

This process ensures that the technical and safety features between the tank farm contractor and the project baselines are fully integrated at the interface. Non-integrated interfaces are forced into "formal" change control to ensure baseline alignment. The interfaces are covered by formal configuration management procedures.

Regulatory Interfaces - A primary regulatory interface between the WTP Project Contractor and the DOE is through the DOE inspection program. The DOE inspection program is described in RL/REG-98-05, *Inspection Program Description for the Regulatory Oversight of the RPP WTP Contractor*. The purposes of this inspection program are described as:

1) Confirming Contractor performance to the authorization basis and Contract in the areas of radiological, nuclear, and process safety
2) Ensuring timely identification and implementation of corrective actions
3) Developing independent inputs for subsequent regulatory authorization or actions thereby fostering regulatory efficiency.

The DOE inspection program is executed in a planned, disciplined, and predicable manner. This is accomplished through appropriate planning, preparation, and performance of inspections and through the use of established protocols.

The project supports the DOE inspection program by:

1) Making available for DOE review, documentation such as program plans, manuals, procedures, instructions, technical reports, self-assessment reports, meeting minutes, records, data reports and event reports
2) Providing briefings and discussions and support interviews on selected subjects as requested by the DOE and prearranged with BNI.
3) Supporting on-location DOE observations of project operations and activities as requested by the DOE and prearranged with BNI.
4) Supporting unannounced on-location DOE observation of project construction, operation, and deactivation activities
5) Attending and supporting pre-inspection and inspection entrance and exit meetings
6) Responding to findings of DOE inspection activities.

The above-mentioned WTP operations and activities to be observed include, but are not limited to, 1) monitoring of equipment performance during operation, inspection, or testing, 2) witnessing of tests, and 3) the performance of independent analyses.

The DOE corrective action/enforcement actions program is described in RL/REG-98-06, *Corrective Action Program Description*. The Project supports the DOE corrective action and enforcement actions program by:

1) Self-identification of non-compliant conditions and the prompt reporting of such conditions to DOE
2) Responding to corrective action notices issued by DOE
3) Prompt implementation of a safety-rework, suspend operation, stop work, and Compliance Orders issued by the DOE.

A number of other external regulatory interfaces are maintained with regulatory organizations external to the Hanford Site (Washington State Department of Ecology, Washington State Department of Health, US Environmental Protection Agency, and Occupational Safety and Health Administration). These interfaces, although not part of the formal interface management system, establish/approve requirements or issue permits applicable to the design and construction of the WTP. These requirements are not primarily directed at radiological, nuclear, or process safety. The WTP Contractor maintains awareness of applicable regulations and interpretations via routine communication meetings with DOE and the regulators and by regular access to regulatory resources, e.g., Code of Federal Regulations, Federal Register, Washington Administrative Code, and governmental web sites.

The E&NS organization manages the interface with the external regulators in the areas of environmental and nuclear safety to ensure that requirements in permits and applicable standards are identified and understood, and actions are implemented to comply with the requirements including resolution of conflicts with design or construction practices. Contractor Business Services performs similar functions for activities that must comply with safeguards and security requirements where DOE is the regulator.

Any conflicts that arise between considerations for safeguards and security and radiological, nuclear, and process safety will be resolved by discussions among the WTP Contractor, DOE, and the external regulators. For construction, plans and procedures have been developed and implemented that define monitoring and reporting activities for this phase of the WTP Project.

Routine meetings between BNI and the DOE regulator offer a forum for identification and discussion of external conflict issues. Permit conditions generally reflect the resolution of issues that have been raised between the WTP Contractor, DOE, and the regulatory agencies. In the event that the permit conditions do not reflect the agreed upon resolution, the Contractor and DOE can comment during the public review process.

When the potential applicability of an existing, new, or revised regulatory requirement is identified, conflicts are evaluated and resolved. The impact on project cost and schedule, along with the feasibility of implementing the requirement, is included in the evaluation. In the cases where safety and environmental regulations conflict, absent the granting of an exemption from the regulation, the more stringent regulation is followed.

17.5.3.2 Internal Interfaces

Formal internal interfaces are managed within the engineering interface control system. The nature of the interfaces within the system includes design responsibilities, information flow, and appropriate documentation. These engineering interfaces are included in the Project Engineering planning process and in the control and execution of the design. An internal interface document is used to capture the functional, physical, or parametric interfaces within the WTP system or system component for each interface identified in a system description.

Most internal interfaces are established in project procedures that identify the responsibilities of individuals and interactions among them. For example, document reviews requiring cross-discipline involvement are performed in accordance with project procedures. Other internal interface activities include the Integrated Safety Management process (section 17.6.1), meetings, and communications.

17.5.4 Staffing and Qualification

Safe and effective design, construction, and commissioning of the WTP depends upon a staff of qualified, competent personnel. It is the project policy to employ only individuals who are qualified by education, industry related experience, and company-sponsored, job-specific training.

The responsible organization identifies those activities that require formal qualification of personnel and the minimum requirements for such personnel. Position descriptions document minimum education and experience requirements for each position commensurate with the scope, complexity, and nature of the work. Only personnel who have experience and education meeting or exceeding the minimum requirements are permitted to perform the organization's activities. Minimum education and experience are verified or, when minimum education and experience cannot be verified, documented justification is provided for the personnel assignment.

When a position is filled, training documents are forwarded to the training organization for record keeping and identification of training needs. Project training provides personnel with the knowledge, skills, and direction necessary to perform their duties in a safe and environmentally sound manner (Chapter 12.0). Training is performed using a tailored approach, commensurate with the level of risk and individual responsibility. The training and development program for the construction phase of the project is described in section 12.4.1.2. The program applies to both manual and non-manual workers.

The project organization shown in the QAM, Policy Q-01.1 Figure 1, is established for the WTP design, construction and commissioning phases and is expected to change to reflect project transitions from one phase to the next. The number of managers, engineers, and support personnel assigned to the project will be adequate to support concurrent design and construction activities. As the project transitions from design to construction, and then to commissioning, staffing levels will be adjusted to ensure that an adequate number of qualified personnel are available for safely and efficiently performing the required work.

17.6 Safety Management Policies and Programs

Administrative policies and programs control the interactions among the project organizations and activities through the integration of safety management into work planning and performance. Such integration protects workers, the public, and the environment by implementing work practices that assist in ensuring the work is performed systematically and correctly.

The following safety management programs are discussed in the remainder of this chapter.

- Section 17.6.1, Project Integrated Safety Management Approach
- Section 17.6.2, Safety Review and Performance Assessments
- Section 17.6.3, Configuration Management
- Section 17.6.4, Document Control and Records Management
- Section 17.6.5, Authorization Basis Management
- Section 17.6.6, Unreviewed Safety Question Process
- Section 17.6.7, Occurrence Reporting
- Section 17.6.8, Safety/Quality Culture

17.6.1 Project Integrated Safety Management Approach

The Integrated Safety Management approach is implemented with the recognition that the defined work of processing and immobilizing Hanford tank waste involves inherent radiological and chemical hazards from which hazardous situations may arise. The WTP Project Integrated Safety Management Plan that furnishes an overview on how DOE/RL-96-0003 requirements for a WTP Project Integrated Safety Management Plan is provided for the Project. The ISMP provides a mapping of where the DOE/RL-96-0003 section 4.1.2.11 requirements for an ISMP are met in the PSAR Volume I.

The WTP Project integrates the development of safety criteria and design requirements, the hazard analysis and accident analysis processes, and the facility design to minimize the risk associated with these hazards and hazardous situations.

The WTP Contractor accepts responsibility for the safety of the WTP and for adequate protection of the health and safety of the public, worker safety, environmental protection, and compliance with applicable laws and regulations.

The safety approach for the Project is based on applying best industry practices and cost-effective processes that come from successful and safe operation in the commercial nuclear environment and the chemical process industry. The purpose of the WTP Project integrated safety management approach is to achieve the following objectives:

1 Ensure adequate level of safety at the facility for the workers and the public
2 Comply with applicable laws and regulations
3 Conform to top-level safety standards and principles stipulated in DOE/RL-96-0006

A diagram of the project integrated safety management approach is presented in Figure 17-1. The safety approach begins with the definition of the work to be performed and continues with the development of the conceptual process flow diagrams and other facility design information required to accomplish the defined work. This conceptual information, which takes into account the hazards identified for similar facilities and the methods by which these hazards were previously eliminated or controlled, is used to identify appropriate hazards-based standards and initiate the development or updating of the SRD.

The safety management processes governing radiological, nuclear, and process safety are identified and developed as a part of development, implementation, and maintenance of the SRD. Development of standards-based safety management programs, through the safety approach as part of the SRD development, has the following benefits:

1) Continually integrates hazards identification, SRD development, design development, and accident analysis during all phases of the facility life cycle through deactivation
2) Documents the safety management process drivers within the SRD. It also ensures the processes are established in accordance with the applicable regulatory, commercial, and U.S. Department of Energy (DOE) standards and the DOE Top-Level Safety Principles as appropriate to control hazards and hazardous situations associated with the WTP.
3) Adopts the use of "best industry practices" that include process safety management, a rigorous design process based on a set of credible accidents and a defense-in-depth philosophy, and verification of the level of facility safety through safety analysis and validation of requirements implementation
4) Documents that the facility design meets the required Safety Criteria and documents how and why the engineered and administrative controls credited for public and worker safety were identified. During commissioning, when policies and procedures are finalized to implement the administrative controls developed during the during the design, construction, and commissioning phases of the WTP Project, these final versions of operational policies and procedures will be identified in the SRD.

Through the SRD development process safety management programs are identified that:

1) Directly implement regulatory requirements for programs that provide protection of the public and workers from radiological, nuclear, and process hazards (e.g., Radiation Protection Program)
2) Are credited for providing adequate protection to the worker or public (e.g., Emergency Preparedness Program)
3) Place controls on the design, operations, or maintenance of structures, systems, and components (SSC) that are credited for providing adequate protection to the worker or public (e.g., Configuration Management, Conduct of Operations, Quality Assurance, Maintenance).

The majority of policies, procedures, and instructions fully defining the safety management programs will be developed and tailored prior to commissioning of the WTP. Procedural development will be based on accepted industry practices for ensuring safety through adequate training, conduct of operations, and engineering and design programs. Procedures will be developed internally by the responsible Project organizations.

When developed, these policies, procedures, and instructions (administrative standards) are linked to the driver requirements (Safety Criteria) contained in the SRD. This linking of implementing standards to Safety Criteria ensures that the safety management programs, as defined in the SRD, are fully implemented.

In addition, the consensus codes and standards in the SRD are used in the design of SSCs are linked to SRD Safety Criteria. This link is implemented through Project documents like the Design Input Memorandum. These links are controlled to ensure that configuration management of the linkage to the SRD is maintained at all times.

A key feature of the SRD maintenance process is the ability to effect changes to the SRD (when such a change is appropriate). SRD changes may arise as a result of design evolution or may be identified through the hazard evaluation process. Changes of the first type occur when a proposed design position offers benefits (cost, safety, reliability) but is not fully in compliance with the SRD as written. Changes of the second type may result from newly identified accidents or off normal conditions. In either case, all activities are documented, and no change to the SRD is initiated without a formal review for compliance with the standards and requirements on which the SRD is based.

A description of the elements of the WTP Project integrated safety management approach is provided in the following subsections.

17.6.1.1 Identification of Work, Hazards, Controls, and Standards

In order to ensure adequate safety of workers and the public and protection of the environment, the laws, regulations, and standards applicable to the radiological, nuclear, and process safety aspects of the Project are incorporated into programs for facility design, construction, and operation.

The identification and characterization of the hazards and hazardous situations establish a basis for describing approaches and measures to control the hazards. Safety criteria are then developed that document the set of standards and requirements necessary to ensure implementation of the necessary hazard control strategies. These safety criteria are documented in the SRD and are based on applicable laws and regulations, the DOE's top-level safety requirements, and best industry practices. The SRD provides safety criteria to the hazard analysis process by which an initial assessment of the adequacy of the design is made.

The Safety Criteria and codes and standards of the SRD are applied to the WTP. The SRD applies to Project contractors and subcontractors. By application of the SRD to all Project activities, a consistent project-wide approach is applied to radiological, nuclear, and process safety matters. The hazards and hazardous situations at the facility will change significantly throughout the construction, commissioning, operation, and deactivation phases of the project. The SRD is developed by an iterative process that will continue as the design matures through the construction, commissioning, operation, and deactivation of the facility. The development involved identifying the work to be performed, identifying hazards and hazardous situations of the facility operation by the hazard assessments and accident analyses, reviewing of pertinent regulations and industry practices, and identifying engineered and administrative controls.

Once the work activity is identified for the project and the hazards associated with this work determined, the Safety Criteria are defined by the requirements necessary to ensure protection of the public and workers from radiological, nuclear, and process hazards. The Safety Criteria are based on the following:

1) Mandated regulatory requirements (statutory and contractual; including those identified as top-level safety requirements [standards and principles]) and equivalent requirements
2) Requirements and guidance documents deemed relevant to waste management facilities such as this Project
3) Best industry practices from the government, commercial nuclear, and chemical industries

The engineered and administrative controls necessary to eliminate and control hazards and hazardous situations are established via the hazard assessment, the accident analysis, and the necessary level of protection required to satisfy the SRD Safety Criteria. Once the controls are selected, the SRD identifies the implementing codes and standards necessary to ensure that engineered and administrative controls are properly designed, implemented, and maintained. The requirements, guidance documents, and practices are incorporated into the SRD, tailored toward applicability to WTP operations, the control of hazards, and the adequacy to protect public and worker health and safety. These codes and standards are used by the appropriate organizations to ensure that the design, construction, testing, and maintenance of Important-to-Safety SSCs are such that they can perform their specified public and worker safety functions when required.

17.6.1.2 Feedback Mechanisms for Design and Controls

As accident prevention and mitigation safety features are identified in the PHA, the resulting facility design impacts are fed back to the SRD process, as required, for further development of more detailed safety criteria and design requirements to ensure all safety features provide their specified safety functions.

As facility design mature, accident analyses are performed to confirm judgements made during the process hazard analysis (PHA) and to further characterize the accident scenarios to demonstrate compliance with radiological and chemical exposure standards for accidents. Additional protection for workers is identified by the PHA, the accident analyses, and the application, as appropriate based on exceeding threshold quantities of hazardous process materials, of process safety management requirements of 29 CFR 1910.110.

17.6.2 Safety Review and Performance Assessments

Safety reviews and performance assessments verify that public and worker safety considerations, and protection of the environment are reflected in the design, procurement, construction, and commissioning of the facility. Internal safety oversight is provided by the Project Safety Committee (PSC). Safety reviews are also conducted in accordance with the AB management process (section 17.6.5) and, beginning with Hot Commissioning, the proposed USQ process (section 17.6.6).

Performance assessments performed by the WTP Project that support safety performance evaluation, among other assessments, include management assessments and independent assessments.

17.6.2.1 PSC Safety Oversight

The Project Safety Committee (PSC) is part of the overall internal safety oversight for the WTP Project. A main role of the PSC is to serve as the independent review team (IRT) required by DOE/RL-96-0004. This role shall include confirming the set of radiological, nuclear and process standards recommended by the Process Management Team (PMT). The PSC defines a review approach, carries out review and comment on the proposed standards, and documents the findings of the review. Resolution of PSC comments shall be documented.

PSC internal safety oversight roles and responsibilities also include reviewing the following items as they apply to radiological, nuclear, and process safety, and providing recommendations to senior project management as appropriate:

- AB regulatory compliance issues
- AB development and maintenance
- Programmatic trends for conditions adverse to quality associated with AB compliance
- Occurrence reports and lessons learned processes effectiveness
- Results from ad hoc assessments requested by the PSC

PSC members shall be selected from several different WTP project organizations and backgrounds to ensure that review is representative of an integrated evaluation of the radiological, nuclear, and process safety matters under consideration. The PSC may make use of subcommittees, as appropriate, to provide oversight to specific WTP Project functional areas or to complete specific radiological, nuclear, and process safety-related review tasks or evaluations.

Relative to radiological safety, the ALARA subcommittee (ASC) is a standing subcommittee of the PSC that is established to review radiological protection/ALARA documents and address matters related to radiological protection and ALARA performance. The ASC supports WTP Project safety improvement as an integrated subcommittee consisting of appropriately qualified individuals appointed by the chairperson of the PSC. In addition to the ASC, as a specific subcommittee used to support the PSC, other WTP Project programs serve to "umbrella" safety improvement initiatives (e.g., quality improvement, management assessment, corrective actions, lessons learned).

As needed, when the Project moves from the design/construction phase to the commissioning phase, the current ASC safety improvement program approach can be expanded to include other radiological, nuclear, and process safety improvement program approaches or safety committees applicable to the commissioning phase.

17.6.2.2 Management Assessments and Independent Assessments for the WTP Project

WTP Project approach taken to provide management assessments and independent assessments, as detailed in the WTP Project QAM, is summarized as follows.

- Management assessments - managers assess the activities of their organizations in order to identify and correct problems hindering the organization from achieving its objective. Formally assessing the organization allows the manager to identify its strengths and weaknesses in a disciplined manner and make appropriate improvements. This type of assessment is discussed in Policy Q-18.3, Management Assessment, of the QAM, which addresses the purpose, implementation strategy, policy, conduct, and managers' responsibilities in the assessment process.
- Independent assessments - individuals who are independent of the organization performing the activity being assessed measure item and service quality, measure the adequacy of work performance, and promote improvement. This type of assessment is discussed in Policy Q-18.1, Independent Assessment (Audit), of the QAM. The QAM addresses the purpose, implementation strategy, policy, and conduct of independent assessments; and the independence and qualifications of assessment personnel, documentation of results, management responses and actions, and responsibilities in the assessment process.

The project's audits and assessments address at least the following safety areas: AB management, radiological controls, nuclear criticality safety (as appropriate), chemical process safety, fire safety, emergency management, environmental protection, quality assurance, configuration management, maintenance, training and qualification, procedures, human factors, occurrence reporting including incident investigation, and records management.

Safety related performance monitoring and performance indicators are used on the WTP Project to verify that safety and other WTP programs, plans, and procedures exist; are in place; are adequate; are functioning as designed; and are in compliance with applicable regulatory or permit requirements. Performance monitoring is addressed as an element of the QAM Policy 18.3 on Management Assessment and, in general, includes, but is not limited to, reviewing records, plans, and procedures; visually observing operations/activities; and interviewing key personnel. Findings are provided in written reports with recommendations for improvements as applicable. During design and construction, the findings are provided to the Project Manager and during pre-operational testing, operation, and deactivation, the findings are provided to the Facility Managers.

Current performance monitoring/performance indicators related to safety that support design and construction activities on the WTP Project (i.e., industrial safety related performance monitoring/performance indicators, such as total recordable case rate and occupational safety and health cost index) are not related to radiological, nuclear, and process safety. As needed, when the project moves from the design/construction phase to the commissioning phase, the current industrial safety related performance monitoring/performance indicators (as addressed in the project procedure for safety performance objectives, measures, and commitments) can be expanded to included radiological, nuclear, and process safety performance monitoring elements.

17.6.3 Configuration Management

The WTP Configuration Management Program ensures that programmatic objectives related to radiological, nuclear, and process safety are achieved as changes to the project technical baseline are made. This applies to Safety Design Class and Safety Design Significant SSCs as a minimum, plant installed software, project interfaces, and AB requirements during design, construction, and commissioning. The configuration management program is based upon ISO 10007:1995(E), *Quality Management - Guidelines for Configuration Management*. The program is implemented through project plans and procedures to ensure that:

- The engineered configuration of the project is controlled to ensure it meets design, performance, and acceptance requirements.
- Approved configuration changes are assessed for their impact on performance and safety.
- The configuration status of the technical baseline is maintained.

The WTP configuration management approach consists of applying four basic elements, as follows:

Identification and Documentation
The activities comprising selection of configured items, documenting their physical and functional characteristics, and allocating a unique identification to the configured items. Contract requirements, safety features and design criteria are identified and maintained in databases for project personnel.

Change Control
Changes to configured items and requirements are controlled under the configuration management program after formal issue of their configuration documents. Change control is a formal process comprised of documentation, evaluation, approval, and implementation. Procedures are developed to

manage changes to the project technical baseline, process chemicals, technology, equipment, and procedures, together with changes to facilities that affect a covered process. The procedures ensure that changes are evaluated for technical justification, compliance with the authorization basis, process safety, codes, standards and environmental regulations, and for indirect impact to other disciplines or activities.

Status Tracking and Reporting
Formal recording and tracking of configured items and their approved changes. Information is recorded, entered into data management systems and relationship links established. Reporting capabilities are available throughout the configured item lifecycle.

Configuration Audit
Examination of configured items and documentation is performed to verify compliance with the approved configuration baseline. Configuration audit consists of both functional and physical confirmation. Functional confirmation is accomplished through review, inspection, and test records that functional and performance requirements are achieved. Physical confirmation is accomplished by examining configured items for compliance to configuration documents.

The configuration management organization develops, maintains, and provides training on the configuration management program for the project. This training is provided to employees as part of the Safety and Quality Design Required Training.

Implementation of configuration management is assessed through management self-assessments and independent assessments performed by Quality Assurance to verify compliance with approved project procedures.

17.6.4 Document Control and Records Management

Document control procedures prescribe the process for preparing, reviewing, approving, storing, and maintaining specified project documents in either hard copy or electronic media. The procedures also establish measures for ensuring that current documents, including revisions are distributed and used at the location where the work is being performed.

The documents describe, define, specify, report, or certify activities, requirements, procedures, results, or plant conditions. They also prescribe processes, specify requirements, or establish design.

QAM requirements for the project records mangement system is provided in Policies Q-06.1, "Document Control", and Q-17.1, "QA Records" of the QAM. These requirements ensure that records are legible, identifiable, retrievable, and protected against damage, deterioration, or loss.

17.6.5 Authorization Basis Management

Changes to the WTP that are proposed during the design, construction, and commissioning phases are reviewed in accordance with the Authorization Basis management process for determining whether prior DOE approval is required.

Changes that impact the project Authorization Basis include those involving the facility design and administrative controls (e.g., procedures, programs, plans, or management processes) that are described in the Authorization Basis, or are relied on to ensure conformance to the authorization basis. Changes to the authorization basis are controlled by the configuration management program and performed by qualified personnel in accordance with project procedures.

AB documentation includes that information submitted in connection with a request for Standards Approval, a request for Construction Authorization, or a request for Operations Authorization as described in DOE/RL-96-0003, Revision 2, *DOE Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*, and any other information submitted by the WTP Project Contractor in connection with these requests. Amendments to this information may be in the form of revisions to the previously submitted documents, or new information that supplements previously submitted information. The AB begins at the Standards Approval regulatory action and continues throughout the design, construction, commissioning, operation, and deactivation of the WTP.

Other documents generated by the regulator or the WTP Project Contractor may become part of the AB for the project. This includes correspondence concerning the safety aspects of the facility design, construction, operation, and plans for deactivation.

In accordance with *DOE Position on Contractor Initiated Changes to the Authorization Basis*, RL/REG-97-13, the Contractor may make changes to the facility or administrative controls if a review of the AB is performed and either:

- The review demonstrates that a proposed change is consistent with the existing AB, or
- The AB is revised or amended prior to the implementation of the proposed change.

During the DC&C phase of the WTP Project the contractor may authorize changes to the facility that deviate from the AB, prior to DOE approval, if the associated changes continue to provide adequate safety to workers, the public and the environment and are implemented in accordance with a BNI safety management process that is consistent with this section.

17.6.6 Unreviewed Safety Question Process

The unreviewed safety question (USQ) process, will be effective following Final Safety Analysis Report approval and implementation for the operations phase (beginning with hot commissioning), will allow project management to make changes to the facility, the procedures, and the AB documents; and to conduct tests and experiments at the facility without prior DOE approval in some cases. It must be established, however, that these changes do not explicitly or implicitly impact the safety basis of the facility, which is comprised of all AB documents including the facility TSRs.

A proposed change, test, or experiment involves a USQ if, 1) the probability of the occurrence or the consequences of an accident or the malfunction of equipment important to safety previously evaluated in the documented safety analyses could be increased, 2) the possibility of an accident or malfunction of a different type than any evaluated previously in the documented safety analyses could be created, 3) a margin of safety is reduced; or 4) the documented safety analysis may not be bounding or may be otherwise inadequate. 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 one of the conditions cited above.

Following approval and implementation of the project AB documents for operation, proposed temporary or permanent changes to administrative and engineered controls are reviewed by qualified USQ evaluators to determine if they would involve a USQ. If the proposed change involves a USQ, one of the following three options is pursued.

1 The proposed activity is abandoned.
2 The proposed activity is modified to eliminate the USQ.
3 The proposed activity is submitted to the regulator for review and approval prior to initiating the activity, if initiation of the activity would itself involve a USQ, or implementing the proposed change.

The DOE also must be notified and a USQ determination conducted when a potential inadequacy in the safety analysis is identified. In this case, situations of concern are those wherein it is found that the current safety analysis may not be bounding or the current safety basis may be otherwise inadequate. This situation could arise from a concern that the current safety analysis may be in error or because the facility configuration may be different from the configuration that was analyzed.

To complete a USQ evaluation, the AB documents are reviewed to determine the impact of the proposed change, test, or experiment on the safety analyses. The USQ evaluation including the basis of the determination is documented and maintained as a record. Changes to the AB documents will be incorporated based on the USQ evaluation results and submitted to DOE on a schedule corresponding to the updates of the AB document. The submittal 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 AB document.

The following organizations have key roles in the project USQ process:

- The E&NS organization will develop the USQ procedure, develop the training and qualification requirements for USQ evaluators, and maintain the list of qualified evaluators.
- The E&NS Manager will approve the USQ procedure and the training and qualification requirements for USQ evaluators.
- The Configuration Management organization will support the project functional organizations in establishing procedures requiring the performance of USQ evaluations of proposed changes, tests, and experiments.
- The PSC will approve a positive USQ determination prior to its submittal to the DOE for approval.

17.6.6.1 Temporary or Permanent Changes to the WTP as Described in the Safety Basis

A change is a permanent or temporary modification or replacement of a feature of the WTP with one that is not equivalent to the original in the design requirements. For example, changes may include jumpers and lifted leads, temporary shielding on pipes and equipment, temporary blocks and bypasses, temporary supports or other equipment used on a temporary basis. Additions (e.g., new systems or structures) and subtractions (e.g., abandoning a system or component in place) are also considered to be changes for purposes of determining if the facility is changed.

Changes to structures, systems, and components not explicitly described in the safety basis are also reviewed because they have the potential for affecting the function of SSCs that are explicitly described. In addition, the process of implementing the change is reviewed for possible development of a USQ.

Changes that alter the design, function, or method of performing the function of an SSC, as described in the safety basis, are within the scope of the USQ evaluation process.

17.6.6.2 Temporary or Permanent Changes to WTP Procedures

Procedures within the scope of the USQ process include operating, chemistry, system, test, surveillance, and emergency procedures that specifically implement provisions of the safety basis.

Changes to activities or controls over functions, facility configuration, task reviews, tests, or safety review meetings that are described or defined in the safety basis are also evaluated as potential USQs.

Changes that result in system operation in a way that deviates from the system operation described in the safety basis (in words or drawings) are within the scope of the USQ evaluation process.

17.6.6.3 WTP Tests or Experiments Not Described in the Existing Safety Basis

A test or experiment is a special procedure for a particular purpose or an evolution performed to gather data. A test or experiment not described in the safety basis documents (that potentially impacts SSCs or processes described in the safety basis) is evaluated to determine if a TSR change or USQ is involved.

17.6.6.4 Changes to a System or Component as Described in the Safety Basis

A change to a safety basis document is within the scope of the USQ process. In addition, differences between the facility and the corresponding description in the safety basis are defacto changes that are within the scope of the USQ evaluation process.

17.6.6.5 Potential Inadequacy in the Existing Safety Analyses (PISA)

Written USQ determinations are required when a potential inadequacy in the existing safety analyses that support the DOE-approved safety basis is discovered. The PISA indicates that the safety analysis may not be bounding. Because the inadequacy has the potential to call into question the information that DOE relied upon in authorizing operations, the project will:

1 Take appropriate action to place or maintain the facility in a safe condition
2 Expeditiously notify DOE upon discovery of the information
3 Perform a USQ determination and submit it promptly
4 Complete an evaluation of the situation and submit it to the DOE prior to removing any operational restrictions implemented to compensate for the analytical discrepancy

If a USQ is determined to be present, the safety evaluation will require not only DOE review but also its approval of resulting changes, before any operational restrictions are removed.

17.6.6.6 Margin of Safety

Margin of safety is the level of confidence that is assigned to the integrity of radiological or hazardous material control measures such as confinement barriers. It is defined as the range between the design acceptance limits and the design failure point of the control feature. The design acceptance limits for radiological or hazardous material control measures such as confinement barriers are established during the design of the facility. These criteria are given in terms of those physical parameters that define their performance. Whenever the values of the design acceptance limits are exceeded, the margin of safety, and, therefore, the confidence in the integrity of the control feature, is decreased. In the event that the margin of safety is reduced, the section 17.6.6.5 actions are performed.

17.6.7 Occurrence Reporting

The WTP project occurrence reporting program provides for the timely identification, categorization, response, notification, investigation, and reporting of abnormal events and conditions. The program also includes the processing of that information to identify the root cause, direct cause, and contributing cause; and to develop appropriate corrective actions to prevent recurrence. Similar occurrences can be prevented by the identification of good practices and lessons learned. The occurrence reporting process is established in a project plan and procedure in accordance with the requirements of DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information*, and its associated manual, DOE Manual 232.1-1A.

The occurrence reporting process described in this PSAR is applicable to the design and construction phases of the project including cold commissioning. This scope is consistent with the project's Construction Occurrence Reporting Plan. The Occurrence Reporting Plan for hot commissioning and operations will be completed prior to hot commissioning.

17.6.7.1 Organizational Responsibilities for Occurrence Reporting

The WTP Project Director is responsible for ensuring the development and implementation of the occurrence reporting program. As a delegated responsibility, the Site Manager appoints an Occurrence Report Coordinator (ORC) who is available at all times to carry out the responsibilities for categorizing, notifying and reporting events and conditions. The E&NS organization will review and approve all notification, update, and final reports prior to uploading them into the DOE Occurrence Reporting and Processing System (ORPS) database.

The project staff is responsible for promptly notifying project management of events or conditions that adversely affect, or could adversely affect public and worker safety and health, quality assurance, security, construction, or the environment. Reportable occurrences include emergencies, unusual occurrences, and off-normal occurrences associated with the Project. The ORC reports all occurrences to the ORP Facility Representative (FR), and the Hanford Occurrence Notification Center (ONC).

The ONC will report occurrences to the DOE Headquarters and other offsite agencies. The ORC is responsible for investigating or designating a team leader for investigating a reportable occurrence, preparing and submitting a report, and trending the investigation results and corrective actions.

17.6.7.2 Discovery and Reporting

Any employee observing events or conditions that have or could have an adverse effect on personnel safety and health, quality assurance, security, operations, or the environment must report the situation to a supervisor immediately. The employee may mitigate the consequences of the event if it does not endanger himself or others. A supervisor observing such a situation or having it reported to him must immediately notify the ORC, initiate or complete immediate actions for stabilizing the situation and ensuring injured personnel are treated, and preserve conditions for a future investigation. Stabilizing the work area or operation to a safe condition takes precedence over notifications.

17.6.7.3 Categorization of Occurrences

Occurrences are categorized as soon as reasonably possible and, in all cases, within 2 hours following identification of the event or condition. Identification is defined as the time the ORC is informed of the event. An occurrence is categorized as an emergency, unusual occurrence, or off-normal occurrence. An emergency is the most serious occurrence and requires an increased alert status for onsite personnel and, in specified cases, for offsite authorities. If an event or condition meets an occurrence threshold and it is not categorized as an emergency, it is categorized as an unusual occurrence or an off-normal occurrence. The classification and notification requirements of emergencies are summarized in Chapter 15, Emergency Preparedness.

An unusual occurrence is a non-emergency event or condition that exceeds the off-normal occurrence threshold criteria. Off-normal occurrences are abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in the safety, safeguards or security; environmental or health protection; performance or operation of a facility.

If categorization is not clear or the occurrence exceeds the threshold of more than one criterion, the occurrence is categorized at the higher level being considered. As an example, discovery of a defective item, material, or service, normally reportable as an off-normal occurrence, that caused the reduction of safety margin below that prescribed in the AB, would be reported as an unusual occurrence. The selected category also may be changed to a higher or lower category as additional information is obtained or as the event progresses.

The criteria developed for the project for categorizing unusual and off-normal occurrences are organized in ten groups, each group relating to a specific area of DOE operation. Some of the groups and the events or conditions in a group are not applicable to the project during the construction phase.

17.6.7.4 Occurrence Notifications

The DOE is informed orally as soon as practicable and, in all cases within 15 minutes, following discovery of a potential emergency event or condition (Chapter 15). The FR and the Occurrence Notification Center (ONC) are notified orally within 90 minutes after categorization of an event or condition as an unusual occurrence and within 30 minutes if it meets the criteria of an abnormal event. The FR is notified orally as soon as practical after categorization of an event or condition as an off-normal occurrence, and the ONC within 2 hours.

A written notification report is prepared and submitted as soon as practical but, in all cases, before the close of the next business day from the time of the categorization (not to exceed 80 hours). The notification report will be submitted electronically, see discussion in section 17.4.7.6, Reporting and Processing System Database.

If an event or condition falls below the reporting thresholds, the ORC will notify the project responsible manager by the close of business (or within 80 hours). The manager will review the event or condition, and at his discretion, initiate an internal investigation in accordance with the project root cause analysis procedure.

All occurrences are reported to the *Price-Anderson Amendment Act* (PAAA) Coordinator for performing an evaluation to determine if the occurrence represents a possible PAAA nuclear safety requirement noncompliance in accordance with 10 CFR 820, *Procedural Rules for DOE Nuclear Activities*. Project Management is informed of the results of the evaluation and appropriate actions initiated.

Notifications to state or Federal agencies of occurrences affecting state or Federal permits or regulations are made in accordance with project procedures. In some cases, an occurrence report to the ORP and the DOE Headquarters - Emergency Operations Center may be required in addition to the state or Federal agency reporting requirements.

17.6.7.5 Occurrence Investigation and Analysis

The investigative process is used to gain an understanding of an occurrence, its underlying causes, and to identify corrective action recommendations for preventing recurrence. All occurrences must have some degree of investigation. A graded approach is applied by the ORC in determining the type and level of effort required to investigate the cause of the occurrence. The graded approach is based on the severity or risk associated with the event or condition (categorization). The investigation can take the form of a meeting with involved individuals, a single person gathering information, a critique, or a root cause analysis team trained in accident investigation techniques conducting a formal investigation. Regardless of the approach, the investigator(s) are independent of the line function(s) involved with the occurrence.

The investigation is initiated as soon as possible commensurate with the safety significance of the event and facility safety but not later than forty-eight hours following the occurrence.

A formal investigation, if required, is conducted in accordance with project procedures for root cause analysis. The investigation team will consist of members having technical expertise in the event under investigation and who are independent with no bias or vested interest in the investigation results. The team members will be trained in accident investigation techniques.

A report is prepared at the conclusion of the investigation, and reviewed by all affected personnel whose job tasks are relevant to the occurrence findings. Investigation may be documented by completing the required field entries when generating an ORPS database report (see section 17.6.7.6). The investigation report will include, at a minimum, the date of the incident, the start date of the investigation, a description of the incident, the factors that contributed to the incident, and recommendations resulting from the investigation.

The categorization process is not the only factor that determines the extent of an occurrence investigation. For example, occurrences that are repeat occurrences will receive more in-depth investigation to determine the reason for ineffectiveness of the corrective actions. Where repeat occurrences or recurring causes are indicated, prompt follow-up action is initiated to identify additional corrective actions for precluding recurrence. These additional corrective actions are tracked to completion and their adequacy verified to ensure correction of the problem. An evaluation is also conducted for repeat occurrences to determine if the trend represents a programmatic failure reportable under 10 CFR 820, *Procedural Rules for DOE Nuclear Activities*.

The training and QA organizations jointly identify root cause analysis methods for use on the project. This may include an evaluation of the course, training materials, instructors, and testing or qualification requirements. Following a training session, the training organization retains evidence of the completion of the course for each trainee, and when requested, provides the names of personnel qualified to perform a root cause analysis.

17.6.7.6 Reporting and Processing System Database

When an event has been categorized as an occurrence, the centralized DOE electronic database ORPS is used to upload and distribute a notification report documenting the occurrence. The notification report is submitted as soon as practical, but in all cases before the close of the next business day from the time of the categorization (not to exceed 80 hours).

Update and final reports are also uploaded in the ORPS. The update reports document changes in categorization, significant or new information about the occurrence, recurring consequences or additional component defects. The update report is submitted, as soon as practicable, but in all cases, before the close of the next working day from the time of re-categorization of the event or condition (not to exceed 80 hours).

The ORPS database is updated with a final report when an analysis of the occurrence has been completed, and the significance, nature, and extent of the event or condition is identified, the root cause, contributing cause(s), direct cause(s) are identified, corrective action(s) to be taken to correct the condition and prevent recurrence scheduled, and lessons learned identified. A final occurrence report is prepared as soon as practical but within 45 calendar days of the occurrence categorization. The report will be retained in the ORPS database for a term determined in accordance with DOE's procedure.

Under certain conditions, a roll-up report can be submitted in lieu of a new occurrence report when a similar reportable event occurs and a previously uploaded final occurrence report documenting the similar type event has been submitted.

The FR is notified of an occurrence prior to uploading the notification, update, and final occurrence reports to the ORPS database.

17.6.7.7 Corrective Action Determination

Corrective actions identified in the occurrence report will be promptly performed. Occurrences that are also conditions adverse to quality will be corrected in accordance with QAM Policy Q-16.1, Corrective Action.

17.6.7.8 Lessons Learned

The lessons learned program includes the identification and dissemination of lessons learned information for the project. The project occurrence reports are maintained and evaluated by the ORC for lessons learned that can be used for improving project performance. Also, the ORPS database is reviewed regularly to identify good practices and lessons learned from similar DOE facilities and reviews relevant events in other technical domains that can be used at the project.

The Lessons Learned Coordinator distributes lessons learned to the appropriate organizations or individuals within the facility including the training department. Information relating to occurrences is evaluated by the training department for incorporation into project training materials. Personnel potentially affected by lessons-learned material can participate in this process by providing feedback on information distributed and identifying information for potential inclusion in training. If applicable, safety and hazards analyses are reviewed and revised, procedures are modified, maintenance practices are changed, and AB documents are revised to incorporate lessons learned that should avoid a recurrence of an adverse work practice or operating experience and lead to improved operations.

17.6.7.9 Feedback and Trending

Trending of project occurrence information, within various performance areas, is used for early identification and correction of deteriorating conditions or potential programmatic failures. The trend data also provide indication that continuous improvement is being achieved in the project. If repeat occurrences or recurring causes are indicated, prompt follow-up action is initiated to identify additional corrective actions for precluding recurrence. The additional corrective actions are tracked to completion and their adequacy is verified to ensure correction of the problem.

An evaluation is also conducted to determine if the trend represents a programmatic failure reportable under 10 CFR 820 (see section 17.4.7.5, Occurrence Investigation and Analysis).

17.6.8 Safety/Quality Culture

Safety/quality culture includes characteristics and attitudes in organizations and individuals that establish safety and quality as overriding priorities. The project approach for developing and maintaining a safety/quality culture includes establishing policies and programs for ensuring that (1) safety awareness is a primary concern of Project Management, and (2) employees at all levels of the project are aware that they have an obligation for ensuring work is conducted safely.

Other policies that establish standards of conduct and job site work rules are communicated to employees. The policies empower WTP employees to stop the activity in which they are involved if the work procedure or process is not clear or the activity appears unsafe. The policies also direct that performance reviews emphasize the requirements for safety and quality.

The safe completion of a quality job requires planning that takes into consideration aspects such as adequate work packages, appropriate level of instructions, evaluation of the impact of the task on other SSCs or processes, and an evaluation of the completed activity. Procedures governing these activities specify that trained and qualified personnel are required to participate in planning process. This includes craft and operations personnel supporting technical and administrative workers.

To ensure that safety and quality procedures are being followed and that the implemented procedures are adequate to facilitate achieving the expectations, assessments of work activities performed and the results of compliance with goals are conducted. Where practices are identified that improve safety and quality, those practices are incorporated into operations. Any required corrective actions identified are tracked to completion. Results of these assessments are provided to managers and workers.

As the Project moves through design, construction, and commissioning, the Contractor revises the goals and procedures to reflect the activities required for each phase.

17.6.8.1 Bechtel Group, Inc. Safety/Quality Culture

Bechtel Group, Inc., the parent company of BNI, holds safety as its first priority and considers it a key value that is fundamental to Bechtel's culture. The safety/quality culture of BNI Corporate is flowed down into the WTP Project.

With an emphasis on zero incidents, Bechtel considers that every accident, and therefore every injury, is preventable. Based on its extensive experience and best practices, Bechtel has developed interrelated field execution procedures, training and education programs, and assessment processes that form a comprehensive environmental, safety, health, and quality management system applicable to all projects. Bechtel management is improving the project safety and quality culture and demonstrating its commitment to effect change in the following key areas: management commitment, employee involvement, environmental safety and health training, worksite analysis, and hazard prevention and control.

17.6.8.2 Waste Treatment Plant Project Safety/Quality Culture

The WTP Project team maintains a strong safety and quality culture. The safety/quality culture includes characteristics and attitudes in organizations and individuals that establish safety/quality as an overriding priority. The WTP project approach for developing and maintaining a safety/quality culture includes establishing policies and programs for ensuring that (1) safety/quality awareness is a primary concern of Project Management, and (2) employees at all levels of the project are aware that they have an obligation for ensuring quality work is conducted safely. To achieve this performance the Contractor has established the following policy:

1) Outlining expectations and performance standards
2) Communicating those expectations
3) Implementing procedures that facilitate achieving expectations
4) Performing assessments to measure the compliance with and the appropriateness of BNI safety goals.

These policies are integrated into the design, construction, and commissioning of the plant in such a manner as to ensure protection of the health and safety of the public, personnel on site, and the environment. The fundamental principles of the project approach to implementing its safety/quality policy are summarized below. These principles support the WTP Contractor safety-first emphasis and are promoted by all elements of the organization in guiding day-to-day decision making and conduct.

- The AB establishes the bounds within which all radiological, nuclear, and process related work may be safely conducted. This principle is promulgated in every chapter of the PSAR. The project has demonstrated its commitment to this principle by identifying and documenting the safety basis of the WTP facilities and activities and by implementing physical and administrative controls appropriate to risk in order to protect the public, the workers, and the environment against identified radiological, nuclear, and process related hazards.
- The project is developing and implementing a formal and comprehensive Integrated Safety Management System. The ISMS systematically incorporates core functions and guiding principles into management and work practices at all project levels. Line management ownership and worker involvement in ISMS functions are key aspects of the ISMS.
- Management is responsible for providing leadership and support to project workers. This responsibility includes establishing goals and standards for work activities and providing the resources and materials necessary to allow workers to succeed. Management fulfills this responsibility through formal planning, coordinating, reporting, and budgeting processes, and through formal and informal interaction with workers.

- Work is planned and performed in accordance with established controls. This ensures repeatable, predictable operation that complies with regulatory requirements and implements safe work practices. The rigorous approach to procedural development, the performance-based approach to training, and the emphasis on following procedures when performing work, demonstrates the project's commitment to working in accordance with established controls.
- Workers are responsible for ensuring excellence and are individually responsible for their own safety and the safety of their coworkers and the facility. The concept of individual responsibility is exemplified by the fact that every worker has the authority to stop work if a procedural step is not clear or cannot be implemented safely. Stop-work authority is emphasized in the orientation training provided to all project workers. Worker empowerment is further emphasized in project implementing procedures, which contain guidance that encourages and requires employees to immediately notify their supervisors upon observing any event or condition adverse to safety, health, quality, safeguards and security, operations, or the environment. An employee concerns program provides another avenue for identifying problems to Project Management if an employee is dissatisfied with resolution through normal channels. Employees may also relay concerns directly to regulatory authorities if other alternatives do not result in correction of the problem.

Other policies that establish standards of conduct and job site work rules are communicated to employees.

The safe completion of a quality job requires planning that takes into consideration aspects such as adequate work packages, appropriate level of instructions, evaluation of the impact of the task on other SSCs or processes, and an evaluation of the completed activity. Procedures governing these activities specify that trained and qualified personnel are required to participate in planning process. This includes craft and operations personnel supporting technical and administrative workers.

To ensure that safety and quality procedures are being followed and that the implemented procedures are adequate to facilitate achieving the expectations, assessments of work activities performed and the results of compliance with goals are conducted. Where practices are identified that improve safety and quality, those practices are incorporated into operations. Any required corrective actions identified are tracked to completion. Results of these assessments are provided to managers and workers.

Increasing individual awareness of the importance of safety, both on and off the job, is accomplished by several diverse methods. Meetings, posters, newsletters, newspapers, project-wide e-mails, etc. convey safety messages. Personnel are trained in safety skills, such as recognizing and reporting unsafe acts or conditions, and conducting work in a safe manner. The checks and balances of audit and review practices provide meaningful, high-quality self-appraisals. Systems and corrective measures are developed that promote preventive rather than responsive actions.

17.7 References

WTP Project Documents

24590-WTP-G63-MGT-001, *Project Integrated Safety Management System Policy*

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan*

24590-WTP-QAM-QA-01-001, *Quality Assurance Manual*

24590-WTP-SRD-01-001-02, *Safety Requirements Document, Volume II*

Codes and Standards

10 CFR 820. *Procedural Rules for DOE Nuclear Activities*, Code of Federal Regulations, as amended.

10 CFR 830. *Nuclear Safety Management,* Code of Federal Regulations, as amended.

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

10 CFR 708. *Criteria and Procedures for Contractor Employee Protection Program*, Code of Federal Regulations, as amended.

ASME NQA-1-1989 Edition, *Quality Assurance Requirements for Nuclear Facility Applications*, American Society of Mechanical Engineers, Fairfield, New Jersey.

DOE Contract DE-AC27-01RV14136, US Department of Energy, Office of River Protection, Richland, Washington.

DOE O 232.1A. *Occurrence Reporting and Processing of Operations Information*

DOE O 414.1A. *Quality Assurance*, US Department of Energy, Washington DC.

DOE/RL-96-0003. DOE *Process for Radiological, Nuclear, and Process Safety Regulation of the RPP Waste Treatment Plant Contractor*, Revision 2, February 2001, US Department of Energy, Office of River Protection, Richland, Washington.

DOE/RL-96-0004. *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for the RPP Waste Treatment Plant Contractor*, Revision 2, February 2001, US Department of Energy, Office of River Protection, Richland, Washington.

DOE/RW-0333P, *Quality Assurance Requirements and Description for the Civilian Radioactive Waste Management Program (QARD),* US Department of Energy, Washington, D.C.

DOE-STD-1027-92. *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports,* US Department of Energy, Washington, DC.

Other References

Price-Anderson Amendment Act of 1988, 42 U.S.C. 2210, et. seq.

Table 17-1 Key Activities Related to Safety – Design Phase

Activities Related to Safety	Functional Area
Planning:	
• Define safety policy and objectives	• project management
• Define critical safety interfaces for the various phases of the project	• project management
• Implement safety policy and objectives	• line managers, all functional areas
• Assign roles for safety-related activities	• project management
• Develop procedures to implement safety objectives and organizational plans	• radiological, nuclear and process safety
• Develop plans and procedures to address internal safety and oversight functions	• radiological, nuclear and process safety
• Develop plans and procedures to address quality assurance and quality control functions	• quality assurance
• Develop plans and procedures for identification and resolution of employee concerns	• human resources
• Develop performance measures	• project management
• Develop employee feedback program	• project management
• Develop configuration management program	• configuration management
• Develop and implement a regulatory commitment tracking system	• radiological, nuclear and process safety
• Develop the Radiation Protection Program	• radiation protection
Analysis/Regulatory:	
• Update Process Hazards Analysis (PHA)	• radiological, nuclear and process safety
• Update Hazard Analysis Report	• radiological, nuclear and process safety
• Identify requirements of the facility design for environmental regulatory compliance	• environmental protection
• Identify requirements of the facility design for Occupational, Safety, and Health (OSHA) Administration compliance	• radiological, nuclear and process safety
• Prepare applications for state and federal environmental permits	• environmental protection
• Update Standards Requirements Document	• radiological, nuclear and process safety
• Update Integrated Safety Management Plan	• radiological, nuclear and process safety
• Prepare limited work authorization request	• radiological, nuclear and process safety

Table 17-1 Key Activities Related to Safety – Design Phase

• Prepare Preliminary Safety Analysis Report	• radiological, nuclear and process safety
• Implement the Radiation Protection Program	• radiation protection
Design Functions:	
• Develop the quality assurance program plan for the design phase	• quality assurance
• Develop facility design that will achieve the defined work activity and satisfy commitments of the construction authorization package	• engineering
• Incorporate into the design measures that minimize the hazards associated with processing and storing radioactive liquid and solid waste, and fissionable materials	• engineering
• Incorporate into the design measures to facilitate performance of Technical Safety Requirement surveillances	• engineering
• Incorporate design features to ensure personnel exposure is as low as reasonably achievable	• engineering
• Identify design requirements for security	• engineering
• Incorporate design requirements for security	• engineering
• Implement consideration for deactivation and decommissioning into the facility design	• engineering
• Verify and validate design products against safety requirements	• engineering
• Implement configuration management control program	• configuration management
• Define acceptance criteria for the construction testing program	• engineering
• Perform systematic design reviews to determine readiness to authorize construction of Safety Design Class and Safety Design Significant systems, structures, and components	• engineering
• Develop and implement the Radiation Protection Program for design	• radiation protection

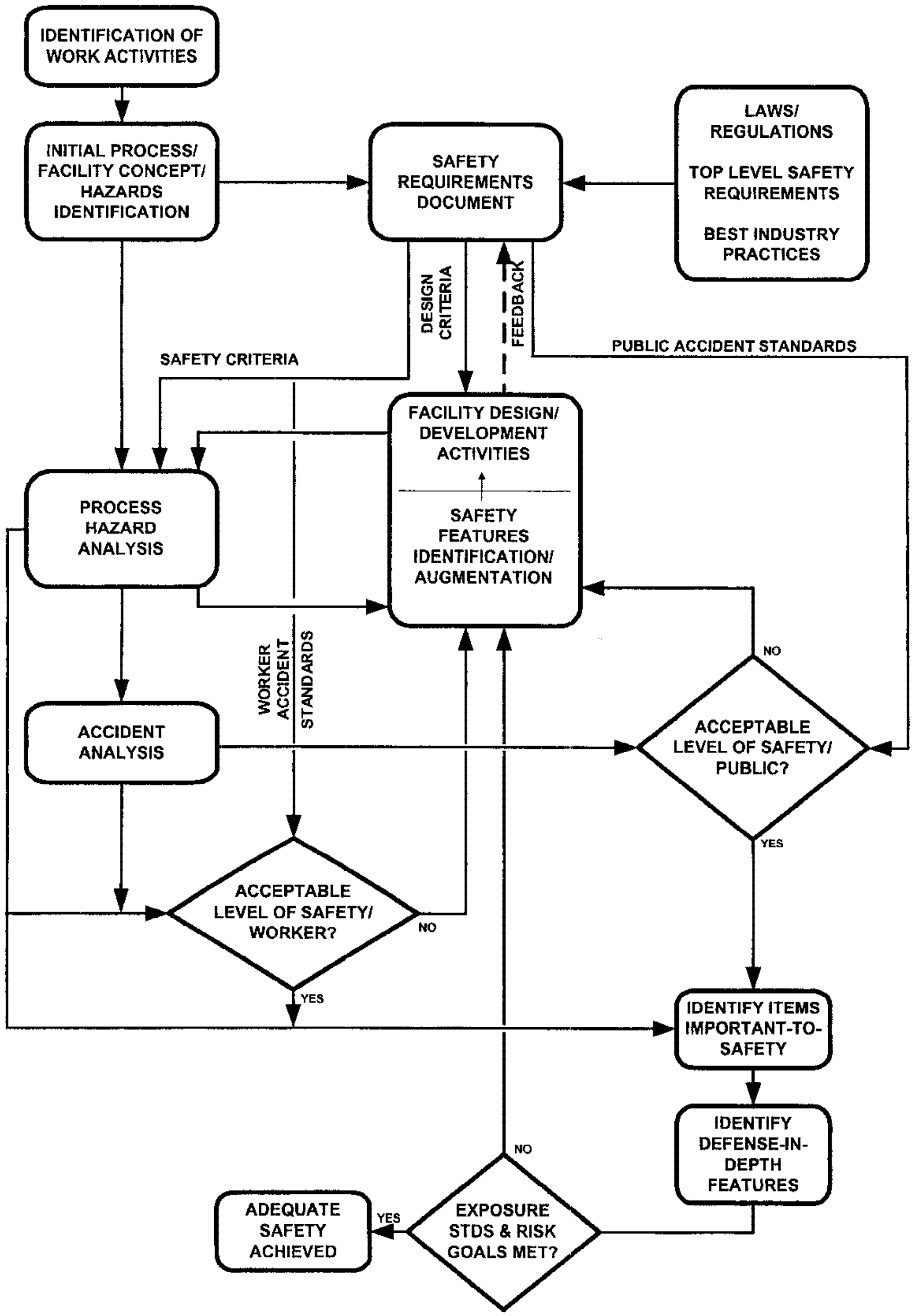
Table 17-2 Key Activities Related to Safety – Fabrication and Construction Phase

Activities Related to Safety	Functional Area
Construction:	
• Implement quality assurance program plan for the construction phase	• quality assurance
• Incorporate regulatory and quality commitments into procurement, fabrication, inspection, and testing	• engineering
• Incorporate regulatory requirements and quality commitments into facility construction, procurement, fabrication, inspection, and testing specification, training, and procedures	• engineering and construction management
• Implement procedures and training to enhance construction safety	• construction management
• Develop a program to ensure that the designer's configuration management program is implemented and that as-built information critical to safety is supplied to the facility operator	• configuration management
• Develop procedures for hazardous material handling, packaging, labeling, and shipping practices	• construction management
• Develop and implement the Radiation Protection Program for construction	• radiation protection
Inspection and Testing:	
• Conduct audits and inspections that verify compliance to requirements by the construction contractor, subcontractors, and Safety Design Class and Safety Design Significant suppliers of systems, structures, and components	• quality assurance
• Implement construction testing program to verify that SSCs meet acceptance testing requirements	• construction management
• Perform a systematic review(s) to determine readiness to authorize facility turnover in preparation for commissioning testing	• radiological, nuclear and process safety

Table 17-3 Key Activities Related to Safety – Commissioning Phase

Safety-Related Activities	Functional Area
Planning:	
• Develop objective and scope for startup testing (scope to include initial and boundary conditions and simulated single failures, as appropriate)	• operations
• Identify the role of design and accident analyses organizations in the identification of the tests to be performed and acceptance of the test results	• operations
• Develop testing program that emphasizes testing with non-radioactive streams	• operations
• Identify tests to be performed and their acceptance criteria	• technical support
• Develop the quality assurance program plan for an operating facility	• quality assurance
• Develop operating staff training program	• operations
• Conduct staff training	• operations
• Develop program for procedure preparation, review, validation, approval, change, deviation, and internal control	• operations
• Define the maintenance program that includes preventive, predictive, and corrective maintenance practices and consider vendor-recommended maintenance activities	• maintenance
• Develop operating procedures	• operations
• Develop administrative procedures	• operations
• Develop maintenance procedures	• maintenance
• Develop procedures for hazardous material handling, packaging, labeling, and shipping practices	• operations
• Prepare Final Safety Analysis Report	• radiological, nuclear and process safety
• Implement a process safety management program	• radiological, nuclear and process safety
Commissioning:	
• Write test procedures • Develop processes for evaluating and resolving unreviewed safety questions and for requesting discretionary enforcement relief from Technical Safety Requirements • Perform testing and document results to acceptance criteria • Collect safety component and process baseline data for future performance monitoring and maintenance planning • Develop and implement the Radiation Protection Program for commissioning	• commissioning • radiological, nuclear and process safety • commissioning • configuration management • radiation protection

Figure 17-1 Project Integrated Safety Management Approach



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History Sheet

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Contents

Revision Status

Document Part	Title	Revision	Pages w/Tracked Revisions
Front Matter	N/A	0c	N/A
Executive Summary	N/A	0a	N/A
1.0	Site Characteristics	0	
2.0	Facility Description	0b	2-69
3.0	Hazard and Accident Analyses	0	
4.0	Important to Safety Structures, Systems, and Components	0	
5.0	Derivation of Technical Safety Requirements	0c	5-2
6.0	Criticality Safety Program	0c	6-2
7.0	Radiation Protection	0	
8.0	Hazardous Material Protection	0	
9.0	Waste Management	0c	9-1
10.0	Initial Testing, In-Service Surveillance, and Maintenance	0c	10-1
11.0	Operational Safety	0c	11-1
12.0	Procedures and Training	0	
13.0	Human Factors	0c	13-1, 13-2
14.0	Quality Assurance	0	
15.0	Emergency Preparedness	0c	15-1
16.0	Deactivation and Decommissioning	0	
17.0	Management, Organization, and Institutional Safety Provisions	0	
18.0	Fire Protection	0c	18-1

Acronyms

A list of acronyms will be provided with a later submittal to DOE.

GLOSSARY

A glossary of terms will be provided with a later submittal to DOE.

5 Derivation of Technical Safety Requirements

Contents

5 Derivation of Technical Safety Requirements

5.1 Introduction

This chapter describes the River Protection Project - Waste Treatment Plant (WTP) plant-wide approach for deriving Technical Safety Requirements (TSR). This common approach is used to derive TSRs for the individual WTP nuclear facilities. WTP facility-specific TSR derivations are detailed in Chapter 5 of each facility-specific volume.

Because the Preliminary Safety Analysis Report (PSAR) defines possible TSRs only as a function of preliminary WTP design and preliminary safety analysis, only draft TSRs are presented with the PSAR. These draft TSRs, as defined by information in the PSAR, may change as design and safety analysis progresses beyond start of construction. Demonstration of the adequacy of the final TSR control set, to ensure WTP operations is within the analyzed safety basis, will be concurrent with design completion, US Department of Energy (DOE) approval, and validation of the final Safety Analysis Report (SAR).

The approach for deriving TSRs for the WTP facilities is based on providing safety basis controls, as credited in the accident analysis and risk goals assessment. These controls are determined necessary to provide preventive and mitigative safety features for these facilities relative to accident conditions and an overall consideration of facility risk.

Specifically, these safety basis controls are based on items described in the SAR related to accident analysis-credited engineered safety features and administrative controls (ACs) to control or mitigate radiological, nuclear and process hazards (including hazardous chemical hazards) that could lead to postulated accidents in the WTP facilities. The TSRs provide limiting conditions for operation (LCO), that specify the lowest functional capability or performance level of equipment required for safe operation of the facility. These LCOs are based on

- Process variables, design features, and operating restrictions that are the initial conditions for accident analysis
- Structures, systems, and components (SSCs) that prevent or mitigate accidents must comply with public and worker radiological and chemical exposure standards of the *Safety Requirements Document* (SRD) (24590-WTP-SRD-ESH-01-001-02) Safety Criteria 2-0.1 and 2-02

The approach for deriving TSRs links the SAR and TSR control elements, for example, safety limits (SL), limiting control settings (LCS), LCOs, surveillance requirements, ACs, and design features, included as needed in the TSR document.

Safety basis controls used to derive the TSRs are based upon engineered safety features and administrative controls, as described in SAR Chapter 3, "Hazard and Accident Analysis," of the facility-specific volumes and upon specific information on engineered safety features for safety design class (SDC) and safety design significant (SDS) features, as provided in facility-specific volumes SAR Chapters 4, "Important to Safety Structures, Systems, and Components."

A graded approach is applied to the results of hazard assessments and accident analyses to derive TSR controls for the WTP facilities. The necessary SDC (and SDS items supporting SDC function) safety systems and accident mitigating systems are identified and their characteristics are defined through analyses of the encompassing bounding accidents. Information flows down from the analyses to provide the bases for TSR controls, limits, and conditions for operation. Derivation of the TSRs, as noted in the TSR bases, explicitly shows this relationship.

Information in this chapter includes the following:

- WTP project-wide requirements and implementing standards for TSR derivation
- TSR applicability overview
- General, WTP project-wide TSR derivation approach and criteria
- Common derivation approaches for the TSRs for individual WTP facilities
- General discussion of the approach for defining modes for WTP facilities
- General discussion on development of minimum staffing requirements
- Overview of common WTP-wide facility-TSR interfaces with other facilities

Chapter 5 of each facility-specific PSAR volume provides the following types of information related to deriving facility-specific TSRs.

- Documentation and tables that link results of the hazard assessments and accident analyses to the WTP facility-specific draft TSRs
- Documentation and tables that cross-reference with SAR chapters for other WTP facilities
- Methodology for deriving minimum WTP facility-specific staffing levels for each operational mode
- Documentation and tables identifying WTP facility-specific TSR interfaces with the TSRs for other facilities

5.2 Requirements

Requirements for development and maintenance of TSRs are described in these WTP Project Authorization Basis documents:

Safety Requirements Document

Section 9.2, Technical Safety Requirements; Safety Criteria 9.2-1 through 9.2-6

The primary requirements for TSRs are provided in the SRD, Safety Criteria section 9.2, Technical Safety Requirements. An accepted approach for deriving TSRs is provided in the respective SRD section 9.2 implementing codes and standards cited for these safety criteria. For the WTP TSRs, this implementing standard is DOE Guide DOE G 423.1-1, as tailored in Appendix C of the SRD.

5.3 Technical Safety Requirement Coverage

Safety analyses provide a logical safety basis for the comprehensive definition of an acceptable safe-operating envelope for the WTP. This safety basis is maintained through derivation of TSRs, in compliance with SRD Safety Criterion 9.2-3 and its tailored implementing standard, DOE G 423.1-1. This safe-operating envelope addresses modes of operation and tests and experiments for which DOE authorization is sought and, as necessary, accommodates normal operations, maintenance, surveillance, testing, and experiments.

Safety analysis, developed through the Integrated Safety Management (ISM) process, explores the safety acceptability of modes of operation, set points and operational parameters, combinations of inoperable equipment, impact of deficiencies in staffing and staff qualifications, and limitations of administrative controls to verify that operation anywhere within the envelope will provide adequate safety. Safety analyses furnish the information necessary to validate, confirm, derive, or modify the bases for TSRs.

The TSR controls are considered necessary and sufficient for public and worker safety, and to maintain radiological and toxicological consequences below SRD exposure standards and within WTP Project risk guidelines.

5.4 Derivation of Facility Modes

5.4.1 Operational Modes

The operational modes for WTP facilities will be defined so that staff clearly understand waste processing conditions. Generally, waste handling (including transfer and waste processing) activities are allowed only in Operation mode.

Modes are imposed to place the WTP facility in applicable restrictive and controlled conditions. Modes will not be defined based on relaxing controls or safety conditions in the WTP facility. The mode applicability for operational controls will be explicitly listed in the individual LCOs.

The hazards in the WTP safety analyses are based on the fact that waste, the source of primary hazard, is typically present. Accidental waste transfers, mistransfers, accidental confinement breaches, and natural phenomena may contribute to defined accidents regardless of mode definition. The waste remains a hazard and potentially available for involvement in an accident regardless of mode. The facility modes reflect the state of waste storage, transfer, or processing at a given time.

If possible, each WTP facility should fit into the general operational conditions and modes listed below. If, however, these modes do not fit a WTP nuclear facility, others may be added, provided they are clearly defined with explicit distinctions between modes (such as a numerical value of pressure, temperature, or flow). The number of modes should be minimized because a WTP facility may encompass various operations that differ in mode, rather than the whole facility being in a single mode. The following general modes, as tailored from DOE G 423.1-1, reflect a broad range of facility conditions. These candidate modes will be considered in the development to the WTP Project TSRs.

5.4.2 Definitions of General Modes

- Operation Mode - the mission or current campaign of the WTP facility is being performed.
- Startup Mode - the WTP facility is operating in a transient state from or near shutdown, to reach conditions where the mission or campaign is performed. This mode is only prescribed for WTP facilities where the procedures are complex and important to radiological, nuclear, and process safety.
- Shutdown Mode - the WTP facility is not performing its mission or its current campaign, and is incapable of doing so in its present condition. (This refers to a process state, not facility shutdown.)
- Warm Standby - the WTP facility is not operating but still retains its inventory of hazardous material.
- Repair Mode - the WTP facility is not able to perform its mission in its current condition.

Submodes may be created and defined as needed by the WTP nuclear facilities. The definition will be clearly written with numerical or other explicit demarcation between submodes. The number of submodes will be limited to avoid complexity and potential confusion.

5.4.2.1 Proposed Modes (preliminary) for the WTP Facilities

Note: Definitions of WTP modes are being developed. Potential modes are discussed below. Three modes will be considered initially: Operation, Standby, and Shutdown.

Operation Mode Mode in which the process area and/or WTP is capable of, or is presently performing, its intended mission. TSR-controlled material transfers, chemical additions, waste pretreatment, feed preparation, and vitrification operations are permitted. Waste is being processed. Waste transfers to or from tanks to melter equipment are authorized in accordance with TSRs. Routine operational and maintenance activities may be performed. The process area and/or WTP is capable of, or is presently performing, its intended mission.

Standby Mode Mode in which operation of the process areas/facilities is restricted. The affected TSR-related systems will be placed in a stable condition that is unlikely to challenge LCOs or to result in an uncontrolled release of hazardous chemical or radioactive material. Cold standby and hot standby submodes may be defined, based on waste melter operational considerations (e.g., cold standby assumption that the cold cap is burned off).

Shutdown Mode Mode in which operation of a process area/facility is stopped. The affected process area shall be placed in a stable condition that is very unlikely to challenge LCOs or to result in an uncontrolled release of hazardous chemical or radioactive material

5.5 Derivation of Technical Safety Requirements

General TSR derivation criteria will be consistent with the following:

- *Hazards Analysis, Development of Hazard Control Strategies, and Identification of Standards* (Procedure 24590-WTP-GPP-SANA-002B)
- The ISM process described in SRD Appendix A
- TSR development guidance in the WTP Project implementing standard (SRD, section 9.2), incorporating DOE G 423.1-1 as tailored for WTP TSRs

Specific TSR derivations based on these criteria are described in Chapter 5 of each facility-specific volume. Each volume's Chapter 5 links the hazard and accident analyses information in the facility-specific Chapter 3 and the safety-basis SSCs in the facility-specific Chapter 4 to the derivation of the TSR document controls (for instance, LCOs, surveillance requirements, ACs, and design features). These facility-specific TSR derivations will be consistent with the general TSR criteria discussed in this chapter.

5.5.1 General Approach

Requirements for derivation and maintenance of TSRs are in SRD Volume II, section 9.2. Safety Criterion 9.2-2 states that TSRs shall be based on the SAR and any facility-specific commitments. Draft TSRs developed during preliminary design and accident analysis, provided to support construction authorization, are based on the information in the PSAR.

Hazard analyses identify the potential sources of safety issues and safety analyses, to determine and analyze a set of bounding accidents that takes into account potential causes of releases of radioactive or hazardous chemical materials. TSRs define the minimum acceptable performance requirements of SDC and SDS SSCs and administrative controls, to confirm that engineered safety features and personnel can perform their intended safety functions under normal, abnormal, and accident conditions.

The content of the SAR must remain valid so that the safety basis of the facility, as implemented in operations through the TSR, remains valid. Therefore, if any changes to the facility or its operations as described in the SAR are proposed, unreviewed safety questions must be tracked and resolved to support TSR maintenance. Likewise, changes to the TSR bases in the SAR (for example, when the SAR is updated each year) will be incorporated into the TSRs to ensure that the information reflects the current safety basis of the facility.

Any proposed revision to a TSR will be examined to ensure that the SAR supports the basis for the change. The TSR rule requires that such revisions be submitted to DOE for review, with the basis for the proposed change. DOE must approve the change to the TSR by before it is implemented.

The SAR includes information on the SDC (and SDS supporting SDC function) SSCs, the ACs, and design features credited to be operable or available, to prevent or mitigate the consequences of accidents. This information is used as the basis for deriving the TSRs.

Based on a review of the results of hazard and accident analyses, TSRs include credited SSCs and activities as follows:

- Safety Design Class includes those SSCs that, by performing their specified safety function, prevent workers or the maximally exposed member of the public from receiving an accidental radiological exposure that exceeds the accident exposure standards defined in the SRD. SDC also applies to those features that, by functioning, prevent the worker or maximally exposed member of the public from receiving an accidental chemical exposure that exceeds the *Emergency Response Planning Guide* (ERPG)-2 (AIHA 1988) accident chemical release standard. Features credited for the prevention of a criticality event are also designated as SDC.
- Additional items that may also be designated as SDC, independent of a specific accident analysis, are items that protect the facility worker from potentially serious events. Typically, these events are deemed to present a challenge to the facility worker severe enough that mitigation is prudent, without the need to perform a specific consequence analysis.
- Safety Design Significant items can, if they fail or malfunction, place frequent demands on or adversely affect the function of SDC items (that is, "II/I" impacts). SDS SSCs are items that protect SDC item function (such as alarms/prompts for operator response).

WTP categorization of SSCs and controls can also include non-TSR controlled items considered important to safety, including items used for defense in depth, items affecting the immobilized waste product, and items that do not have a credited radiological, nuclear or process safety function. The selection methodology in this chapter is limited to guidance for TSR derivation and addresses only items with hazard and accident analysis-credited functions.

WTP worker safety programs are covered by ACs implemented through ISM programs. These programs reduce the likelihood and potential impacts of accidental operational events and are covered by their respective regulatory and contractual systems of basic requirements. These programs are discussed in the AC section of the TSR document. TSR controls addressing worker safety requirements, as necessary to support safety basis and credited controls in the SAR accident analysis, can also use TSR elements other than ACs to ensure the availability of these controls (for instance, LCOs/safety requirements for SSCs requiring operability confirmation). The selection of an LCO/safety requirements control rather than an AC control for worker safety is determined case by case, as a function of the significance of the worker hazard and the approach preferred to protect the control.

5.5.2 Approach for Deriving Specific TSRs

To derive the TSR control set, the SAR (particularly the safety bases in the SAR) serves as the source documentation. The requirements to be included in TSRs are derived from the SAR facility-specific safety analyses. These analyses consider credible hazards, including the most significant possible releases of radioactive and other hazardous materials (with bounding accidents termed design basis events), criticality scenarios, and other accidental releases expected during the lifetime of the facility. Examination of the hazard and accident analyses fulfills the following purposes:

- Yields safety-basis assumptions and values for defining the operational limits and ACs necessary to ensure that the facility is not operated outside the bounds assumed in the hazard and accident analyses
- Identifies parameters and operating conditions that should be limited to reduce, provide warning of, and mitigate the uncontrolled release of hazardous materials or to prevent inadvertent criticality

TSRs are expected to include the following requirements:

- Operating limits for principal process parameters
- Technical and administrative conditions that must be met
- Availability of safety equipment and systems
- Safety functions of instrumentation and controls

Operation within the bounds of the resulting requirements will provide reasonable assurance that the WTP facility will not threaten the health and safety of the public or pose an undue risk to workers from uncontrolled releases of radioactive or other hazardous materials or from inadvertent criticality.

If the SAR documents do not directly supply the input for the TSR for a particular area (such as surveillance intervals and acceptance criteria), national and international codes, standards, and guides are used. Use of values less conservative than those in applicable codes, standards, and guides will be justified in the SAR. Where codes, standards, and guides conflict, the selection of a particular code, standard, or guide will be justified; normally the most conservative is selected. Where no code, standard, or guide is applicable, other documents (such as risk assessments and manufacturer documentation) may serve as a basis, and a justification will be placed in the SAR.

By requiring the facility to operate within predetermined safety requirements, the TSRs protect the public health and safety and that of co-located workers, and reduce the risk to facility workers. The TSRs are based on maintaining worker exposures below acceptable levels during normal operations (through ACs and design features), and after an accidental uncontrolled release of hazardous material or inadvertent criticality. Risk to the workers is reduced by decreasing the likelihood and potential impact of such events, to meet worker accident exposure standards in SRD Safety Criteria 2.0-1 and 2.0-2.

Safety management programs such as industrial hygiene and radiation protection (e.g., monitoring of worker exposures, use of personal protective equipment, and emergency evacuation planning), as well as TSRs reduce the impact to workers of an accidental release of radioactive or hazardous materials. The facility safety and health programs address control of the levels of hazardous materials to which workers may be exposed. These programs are incorporated by reference in the AC section of the TSR. Because of the necessary and inherent presence of hazardous and radioactive materials in the facility, and worker proximity to these materials, it is impractical to reduce worker risk to an insignificant level by selecting operating limits in TSRs. Protection of the health and safety of workers is ensured by the combination of the derivation of TSRs for barriers to uncontrolled releases and for preventive and mitigative systems, components, and equipment; use of personal protective equipment; emergency protection programs, and compliance with safety management program requirements.

The scope and content of TSRs will include only the most essential radiological, nuclear, and process safety requirements, to make the TSR document more operationally useful for controlling facility safety. The TSRs will be written in clear, concise language appropriate to the facility operating organization.

Management of hazardous materials is regulated under the provisions of the Resource Conservation and Recovery Act, Washington Administrative Codes, and other environmental management regulations. Worker exposure to hazardous materials and/or conditions is also regulated under the provisions of the Occupational Safety and Health Act. Compliance with applicable federal and state regulatory requirements is necessary, in addition to compliance with TSR document limits.

5.5.3 TSR Derivation Considerations

TSR derivation criteria provide the TSR preparer with considerations for the establishment of tailored nuclear facility operating limits included in the TSR, to

- Preserve the integrity of accident analysis-credited safety basis barriers
- Ensure that the facility operates within the bounds of initial conditions assumed in the accident analysis
- Preserve the capability to prevent or mitigate the consequences of postulated transients and accidents
- Prevent inadvertent criticality

Facility-specific TSRs are derived by systematically applying a selection methodology to the results of the hazard and accident analyses. This approach identifies essential protection sequences (primary success paths), other lines of defense, and the equipment and other operational controls that satisfy safety criteria related to hazard and accident analysis.

The process involves evaluating postulated facility events in relation to specified acceptable limits. If a system or operational control provides a required safety function in an essential protection sequence, it is assumed to be part of the primary success path. Derivation of safety requirements must also consider support systems (such as electrical power sources, instrument air), crucial to the operation of these front-line systems, that would be activated in their assigned safety function.

Minimizing "unnecessary challenges" to safety features will address the possibility that a system may malfunction or simply not operate as anticipated when called on to provide its assigned safety function.

5.5.4 Focus of TSR Derivation Considerations

Excessive use of TSR limits to manage operations would distort the regulatory structure DOE is developing, and dilute the emphasis on the most essential controls. Therefore, TSRs will be selected judiciously, and will not be used to cover the many procedural and programmatic controls necessary to establish the WTP's safety envelope.

Establishing a TSR selection methodology provides a consistent, technically defensible approach for deriving the TSRs. The guiding concept of the TSRs is to provide an acceptable, uniform level of safety assurance for the types of facilities and operations in the WTP. To derive TSR controls, the following points are considered:

- Judicious determination if the minimum, appropriate set of controls used to develop operational limits such as LCOs.
- TSRs to support safety basis assumptions, but not credited to meet exposure standards, do not have safety limits and are not required to use operational limits (such as LCOs). They will, however, be covered in the ACs, at a minimum. Use of design features can also be considered for these controls.
- When ACs are used, these controls must be defined in enough detail to provide a clear understanding of what is controlled, why, and how.
- The only candidates for safety limits will be SDC items which, if exceeded, would have a high probability of exceeding exposure standards. It is not anticipated that safety limits would be required for the WTP.

5.5.5 Application of TSR Derivation Screening

The purpose of TSR derivation screening is to provide a method for deciding which items will potentially be placed in a TSR. The specific selection of preferred control strategies and the development of required controls, as a function of accident analysis credited safety function, is addressed through the ISM process. Chapters 3 and 4 of the SAR document the results of this ISM process control strategy development. SSCs controls and ACs are covered in Chapter 3, and engineering design details of SSCs controls are discussed in Chapter 4.

SSCs and instruments whose failure before or during an accident would not noticeably affect the course of the accident sequence will not have TSRs applied to them. Because they are written in general, qualitative terms, the screening criteria alone are not sufficient to make a decision on items to include in the TSRs. To determine which accidents are of a magnitude to threaten the public, specific quantitative accident exposure limit standards must be used as well.

The SRD provides exposure standards that allow a quantitative determination of the SSCs and non-equipment controls credited to meet accident analysis and normal operation safety criteria.

To meet SRD Safety Criteria 2.0-1 and 2.0-2, radiological and chemical exposure standard values are established so that the adequacy of the results for credible accidents and exposures associated with normal operations can be evaluated.

The quantified consequences developed from accident analyses are compared to the numeric exposure standard values to identify SSCs, non-equipment controls, and any accident-specific assumptions requiring coverage by TSRs. TSRs resulting from this comparison will be directly related to the protecting the offsite public and workers from these accidents. Accident analysis results will be deemed acceptable based on selection of parameters that make it unlikely that the estimated consequence or risk to the public and workers associated with an WTP accident model will exceed the exposure standard values.

SDC SSCs include those that, by performing their specified safety function, prevent workers or the maximally exposed member of the public from receiving an accidental radiological exposure that exceeds the exposure standards defined in the SRD. SDC also applies to those features that, by functioning, prevent the maximally exposed member of the public from receiving a chemical exposure that exceeds the ERPG-2 chemical release standard or prevents the worker or co-located worker from receiving a chemical exposure that exceeds the ERPG-3 chemical release standard. Features credited for the prevention of a criticality event are also designated as SDC.

The nature of accidents analyzed is specific to the hazards associated with the WTP facilities. The categories of accidents examined for the WTP are internally initiated operational accidents (such as explosions, fires, spills, criticality), natural phenomena events (such as earthquakes, high winds) and external man-made events (such as aircraft crashes, adjacent facility events).

For internal and external events, the facility accident analysis will compare individual design basis events over the frequency range of normal operations and credible accidents against the exposure standards. Comparison to exposure standards is performed for the subset of accidents used to define needed controls to limit public risk. SSCs required to meet exposure standards are designated as SDCs and must be included in the facility TSR document. Also, TSRs can be developed for non-hardware controls (e.g., administrative controls) that are necessary to meet the exposures standards.

5.5.6 Derivation of Operational Limit Elements of TSRs

Each portion of a facility that contains radioactive or other hazardous material in sufficient quantities to affect the health and safety of the public or pose a risk to workers is subject to being covered by a TSR. Selection criteria are used for the three types of possible operational limits to be included in TSRs (safety limits, limiting control settings, and LCOs.

5.5.6.1 Safety Limits

DOE-RL-96-0006 defines Safety Limits:

> "Safety Limits are limits on process variables associated with those physical barriers, generally passive, that are necessary for the intended facility function and that are found to be required to guard against the uncontrolled release of radioactive material to workers or to the general public."

Usually, only DOE Hazard Category 1 nuclear facilities (reactors) require Safety Limits. No safety limits are envisioned for the WTP, but they will be provided if warranted by the safety analysis.

Safety limits, if exceeded, could directly cause the failure of one or more of the barriers that prevent the uncontrolled release of radioactive or other hazardous materials.

For non-reactor nuclear facilities, these barriers are typically the process material boundaries (tanks, piping, vessels, and so on). Safety limits of importance for non-reactor nuclear facilities are facility-specific, but often relate to pressure differential across barriers, combustible/flammable material limits, and process heat limits. Therefore, a filter system that is the only barrier between a process and the environment may require a safety limit.

5.5.6.2 Limiting Control Settings

DOE-RL-96-0006 defines Limiting Control Settings:

> "The settings for automatic alarm or protection devices related to those variables having significant safety functions."

Note: Usually, only DOE Hazard Category 1 nuclear facilities (e.g., reactors) typically require limiting control settings to support safety limits. No LCS are envisioned for the WTP, but they will be provided if warranted by the safety analysis.

LCS are those settings of instruments that monitor process variables and that either initiate protective devices themselves or sound an alarm to alert facility personnel to take action in order to protect barriers that prevent the uncontrolled release of radioactive or hazardous materials.

When an LCS is specified, the setting must be chosen so the action (either automatic or manual) taken upon exceeding the setting will correct the abnormal situation before its associated safety limit is exceeded. An example of a limiting control setting might be high differential pressure across a ventilation filtration system.

5.5.6.3 Limiting Conditions for Operation

DOE-RL-96-0006 defines Limiting Conditions for Operation:

> "The lowest functional capability or performance level of equipment required for safe operation of the facility."

SRD Safety Criterion 9.2-3 specifies the following bases for deriving LCOs (emphasis added):

- Process variables, design features, and operating restrictions that are the initial conditions for *accident* analysis
- SSCs that must function to prevent or mitigate *accidents* to achieve compliance to *offsite* radiological and chemical exposure standards of Safety Criteria 2-0.1 and 2.0-2

Derivation of LCOs should be considered for SSCs, operating parameters, or activities that meet one or more of the following criteria:

Criterion 1 - Installed instrumentation used to detect and indicate (in the central control room or other control location) an inadvertent criticality or a significant degradation of a physical barrier that prevents the uncontrolled release of radioactive or other hazardous material that could threaten the health and safety of the public or pose a risk for workers.

This is most applicable to instrumentation monitoring a primary isolation barrier, which can be the process material boundary. Typical instrumentation would be that used to detect leakage from a tank, pipe, process vessel, and so on, that makes up the primary isolation. Other instrumentation could include various types of radiation and chemical monitors, flow (gas or liquid), pressure, and others, depending on design.

Criterion 2 - A process variable, design feature, or operating restriction that is an initial condition for accidents or transient analyses that involve the assumed failure of or present a challenge to the integrity of a radioactive or hazardous chemical barrier.

These variables will be identified from a search of each transient and accident examined for the facility. Initial condition(s) of a process variable relied on in these analyses to provide reasonable assurance of acceptable consequences will be covered by an LCO, established at a level that ensures that the process variable is not less conservative during actual operation than assumed in the accident analyses. If the accident analysis consequences have been limited because of an assumed value of a given parameter, that parameter must be identified as an LCO parameter. Those conditions specified to constrain accident consequences to within exposure standards are used to derive LCO parameters.

Criterion 3 - SSCs relied on in the safety analysis as a primary success path, and that function to prevent or mitigate accidents or transients that assume failure (or challenge the integrity) of a physical barrier that prevents uncontrolled release of radioactive materials that could threaten the health and safety of the public or pose a risk for workers.

This selection criterion is intended to include SSCs that are part of the primary success path of a safety sequence and the support systems necessary for them to function successfully. The primary success path is the sequence of events assumed by safety analysis that leads to the conclusion of a transient or accident with acceptable consequences. Hence, any credited SSCs in that assumed sequence could be included in an LCO. Each transient or accident analysis that challenges the integrity of a radioactive or hazardous material barrier, or involves its assumed failure, will be studied to compile a list of involved SSCs.

Radioactive material barriers are typically the process material barrier and the confinement or containment. Systems that automatically place the facility in a safe condition, such as instrumentation and controls that trip or slow processes and automatic isolation systems, are included. Other items that might be included, if credited in the safety analysis to be operable to support these safety functions, are emergency power sources (diesel generators), fire detection/suppression, and possibly seismic detection instrumentation. Confinement/containment requirements are in this section of LCOs.

SSCs to be taken as candidates for derivation of LCOs will include only those that meet the qualifying definitions. However, additional SSCs not directly involved in the primary success path may be considered for inclusion as LCOs, based on worker safety considerations. Maintaining the LCOs at a minimum number will emphasize their importance and better ensure compliance.

Criterion 4 - Systems and equipment that are used to handle fissile materials.

LCOs written to cover this equipment will incorporate the double-contingency principle, which requires that at least two unlikely, independent changes in process conditions would have to occur concurrently, to make a criticality accident possible. Hence, inadvertent criticality protection shall be provided by either the control of two independent process parameters (the preferred approach, if practical) or a system of two or more controls on a single parameter. No single failure shall result in the potential for a criticality accident. Mass/density limits, geometry/spacing, the use of neutron poisons, measures necessary to prevent unplanned transport of materials to an unfavorable geometry, and so forth, are parameters or conditions that may be controlled to meet this requirement. Note: For the WTP, the approach planned for criticality safety control is the use of administrative limits on fissile material concentrations in waste streams. The specific TSR(s) to ensure criticality safety will be based on limiting the concentration of fissile material in wastes processed by the WTP, to preclude accidental criticality from these materials.

5.5.6.4 Safety Limits/Limiting Control Settings

As defined in the DOE document, DOE-RL-96-0006, Revision 1, *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*, safety limits are defined as limits on process variables associated with those physical barriers, generally passive, that are necessary for the intended facility safety functions and that are found to be required to prevent release of unacceptable levels of radioactive material to workers or the general public.

As defined in DOE-RL-96-0006, LCS are settings for automatic alarm or protection devices related to those variables having significant safety functions. LCS are associated with meeting safety limits and are conservatively selected, such that automatic or manual protective action will correct an abnormal situation before a safety limit is exceeded.

Safety limits, if used, are reserved for a small set of extremely significant features that prevent potentially major offsite or onsite impact. Criteria for the selection of safety limits are established as the following set of elements, which must *all* be true before a safety limit is selected for any of the defined bounding accidents.

- A primary passive barrier failed
- Passive barrier failure was the direct result of exceeding a physical parameter
- This physical parameter can be directly measured by field personnel (for instance, tempered water temperatures)
- Radiological consequences without controls exceed either onsite risk evaluation guidelines or offsite accident release limits
- The physical parameter limit prevents an accident from occurring rather than mitigating an accident after it has already occurred

LCS are setpoints on safety systems that control process variables to prevent exceeding safety limits. The specific setpoints are chosen such that, if exceeded, sufficient time is available automatically or manually to correct the condition before exceeding safety limits. The LCS are normally combined with their respective LCOs. By combining the LCS with the LCOs, the LCS setpoint becomes part of the operability of the system. Safety is enhanced by placing the applicability, actions, and surveillance for a system in a single location, and the complexity of the TSR document is reduced.

5.5.6.5 Limiting Conditions for Operation

LCOs are prepared for systems, equipment, or conditions that provide safety functions and meet one or more of the following descriptions:

- SSCs relied on in the safety analyses to prevent or mitigate accidents or transients that involve the assumed failure of, or present a challenge to, the integrity of a physical barrier to the release of radiological or hazardous material
- Process variables or environmental or facility conditions that are initial conditions for those design basis accidents or transient analyses that involve the assumed failure of, or present a challenge to, the integrity of a physical barrier
- Experiments and experimental facilities that could provide a path through barriers to the release of radiological or hazardous material or that affect criticality safety
- Systems and equipment used for handling fissile material when identified in the accident analyses as being part of the primary success path to providing an acceptable risk of facility operation
- Installed instrumentation used to detect and indicate a criticality accident or a significant degradation of physical barriers to the release of radiological material

5.5.7 Administrative Controls

ACs are established as necessary to support operating limits provided by safety limits, LCS, and LCOs and to provide requirements that maintain the safety basis of the facility as described in the safety basis documentation.

The requirements in SAR Chapters 6 through 18 that form the basis for the AC programs are contractual requirements. Some of the programs may be administered by contractor organizations outside of the WTP Project organizational structure. The minimum requirements for each AC program are found in the Program Key Elements sections of the TSR document.

5.5.7.1 Staffing Levels

Note: The minimum staffing levels in the various WTP facility configurations are being defined. The following general discussion is an initial step in providing a general approach for development of this section and the facility-specific TSR derivations.

The required staffing of operating shifts for WTP facilities and the positions required in the control room or control area for different operating conditions will be specified in the Administrative Control section on the basis of relevant safety analyses. WTP facility staff likely to be needed include facility managers, shift managers, shift supervisors, control room operators, field operators, radiological control technicians, and emergency response organization staff.

The minimum staff in each mode will be provided as considered adequate to perform the minimum safety functions necessary to protect the health and safety of the public, co-located and facility workers, and the environment during normal operations, and during abnormal and emergency conditions. This section of the Administrative Controls will include the maximum daily working hours and maximum number of consecutive days on duty.

The minimum staff can be shared with other WTP facilities for which facility or operation training was received. The minimum staff need not be at a specific facility or operation continuously. If (for unforeseen reasons) staff levels fall below the minimum, and the remaining staff is not adequate for mandatory activities, immediate action will be taken to restore staffing. Until staffing returns to minimum levels, the scope of operations will be reduced to ensure protection of the health and safety of the public, co-located and facility workers, and the environment during normal, abnormal, and emergency conditions.

Minimum staff levels will be determined based on ensuring that TSR compliance and emergency initial notification and initial response needs are met. The minimum staff to meet TSRs does not include individuals necessary to fulfill the WTP Project waste processing mission, goals, and objectives, or to meet other safety, environmental, and Authorization Basis requirements and commitments.

SAR Chapter 12, "Procedures and Training," addresses qualification training for minimum staff (managers, engineers, operators, and radiological control technicians). The qualification program for the minimum staff meets federal, DOE, and state requirements. Initial qualification requirements include education, experience, medical considerations, or an equivalency thereof. Requalification and continuing training are provided as applicable. Staffing requirements for emergency response are addressed in SAR Chapter 15, "Emergency Preparedness Program."

Normal Operations - The minimum staff during normal operations is necessary to (1) safely operate WTP facilities, (2) perform required TSR surveillances for LCO compliance (during the normal 12-hour shift), and (3) provide radiological and hazardous material control. Less frequent surveillances (such as system calibrations and functional tests and AC program commitments) are planned and scheduled to ensure TSR compliance. Additional staff is provided as necessary to safely operate, support, and maintain WTP facilities.

Abnormal Conditions - The minimum staff during abnormal conditions is necessary to perform required actions specified in LCO action statements with completion times of "immediately" to ensure TSR compliance.

Emergency Conditions - The minimum staff during emergency conditions is necessary to respond to the spectrum of accidents analyzed in Chapter 3. The minimum staff must make prompt initial notifications and implement initial protective actions to preclude or reduce the exposure of individuals affected by hazards or unsafe conditions during an emergency. The shift manager and shift supervisors must be qualified as facility emergency coordinators. Specific functions performed by the minimum staff in an emergency include the following:

- Classify events
- Make initial prompt notifications
- Implement alarm response, plant response, and emergency management procedures
- Perform administrative functions such as preparing occurrence reports
- Communicate facility status, and respond to questions
- Support the DOE Office of River Protection

- Staff the Emergency Operations Center

The minimum operations shift in the various facility modes is established in each facility TSR ACs, based on the minimum staff for each mode considered adequate to perform the minimum safety functions to protect the health and safety of the public, co-located workers, and the environment during normal operations, as well as abnormal and emergency conditions.

5.6 Design Features

Design features are those not covered elsewhere in the TSRs that, if altered or modified, would significantly affect safety. Design features are usually permanent, built-in features that do not require (or infrequently require) maintenance or surveillance, and that are usually not subject to change by operations personnel. The categories of design features to be addressed include the following:

- Vital passive components such as piping, vessels, supports, confinement structures, and containers.
- Configuration and physical arrangement of the facility where safety is a concern, including site characteristics such as locations of public access roads, co-located facilities, facility area boundaries, site boundaries, and distances to the nearest residences.
- Building materials, if the safe operation of the facility depends on any component being constructed of a particular material.
- Changes to design features are considered significant modifications. The unreviewed safety question process ensures that changes to design features are analyzed and controlled so that they do not adversely degrade the safety of the facility. The configuration management system that controls changes to design features is discussed in PSAR Chapter 17, "Management, Organization, and Institutional Safety Provisions."

Design features for each of the facilities that, if altered or modified, would have significantly affect safe operation are identified in the facility-specific SAR volumes. The TSR design features are summarized in Appendix B of the facility-specific TSRs. These design features are described in Chapter 2, "Facility Description." Their safety functions are described in SAR Chapter 4, "Safety Structures, Systems, and Components."

5.7 Interfaces with Technical Safety Requirements from Other Facilities

The WTP facilities interface with each other and with Hanford Site facilities both physically and administratively. These interfaces include utilities, fire protection, emergency preparedness, waste management, and WTP material transfers. WTP Project programs will be put in place to ensure that interactions with other facilities and their safety requirements do not affect the safety basis of the WTP Project facilities and do not exceed the safety analyses requirements.

The following discussion includes a description of the utilities, fire protection, emergency preparedness, and waste management interfaces and applicable safety programs. The SAR material-transfers section includes a description of the transfer interfaces and TSRs required between WTP Project facilities where waste material is being transferred or received.

The balance of facilities (BOF) TSRs can affect the operation of the WTP process facilities in various ways. This BOF SAR discusses the potential impacts of BOF TSRs on other process facilities (specifically, High-Level Waste, LAW, and Pretreatment facilities). The impact of entering a BOF TSR is discussed by describing the effect of the condition that could affect the process facilities. In some cases, the impact on one process facility can be quite different than the effect on another process facility. In some cases, there is no impact on a process facility.

BOF interfacing TSRs include controls for the following areas:

- Emergency diesel generators (EDGs)
- ITS switchgear heating, ventilation, and air-conditioning
- Glass former facility (interfacing TSR with high-level waste)

The transfer lines are the primary method of moving radioactive wastes around the WTP facility. Untreated waste will be received from the Hanford Tank Farm at the WTP receiving area at the WTP site boundary. A transfer line will bring the waste to the pretreatment building to begin processing. The waste will be segregated into different waste streams for processing and further transfer depending on activity level (high-level waste and low-activity waste).

Transfer lines will transport the treated wastes to the High Level Waste or Low Activity Waste facilities. A source inventory receipt control program will ensure waste transfers from the Pretreatment facility to High Level Waste facility and the Low Activity Waste facility are controlled to ensure accident analysis assumptions on source terms in these facilities are protected. Additional transfer lines will be able to return the wastes to the pretreatment building for further processing. The transfer lines will be monitored for leakage of radioactive waste. Monitors will alarm in the Pretreatment facility control room, notifying operators that leakage has been detected in the specific transfer line and that prompt mitigative and corrective action is required.

The TSRs for the EDGs will allow the process facilities to achieve a safe state if normal offsite is not available. The demands on the EDGs are different for each process facility. Situations that could affect the EDGs and the process facilities achieving a safe state include the following:

- Maintenance of EDGs
- Loss of all EDGs (common cause)
- Complete loss of offsite power to the WTP
- Loss of offsite power to a single process facility

5.8 References

Project Documents

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan.*

24590-WTP-SRD-01-001, *Safety Requirements Document.*

24590-WTP-GPP-SANA-002B, *Hazards Analysis, Development of Hazard Control Strategies, and Identification of Standards.*

Codes and Standards

AIHA 1988. *Emergency Response Planning Guide*, American Industrial Hygienist Association, Akron, Ohio.

DOE 2001. *Implementation Guide for Use in Developing Technical Safety Requirements*, DOE Guide DOE G 423.1-1, 24 October 2001, US Department Energy, Washington, DC.

DOE 2001a. *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for RPP Waste Treatment Plant Contractor*, DOE-RL-96-0006, February 2001. US Department Energy Richland, Washington.

6 Criticality Safety Program

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6 Criticality Safety Program

6.1 Introduction

This chapter summarizes the results of the criticality evaluations documented in the *WTP Criticality Safety Evaluation Report*, 24590-WTP-RPP-NS-01-001 (CSER), and summarizes the criticality safety program (CSP).

The CSER calculation summaries (section 6.4, Criticality Limits and Controls) show that the River Protection Project - Waste Treatment Plant (WTP) processes will remain safely subcritical ($K_{95/95} \leq k_{safe} = 0.95$) under all credible normal and upset conditions, based on the low fissile concentration in the liquid portion of the feed and the low fissile loading and large neutron poison/Pu ratios in the solids. Controls on feed sampling will be sufficient to ensure that processing feed that will exceed criticality safety limits (CSL) is not credible. Evaluation of the WTP processes and systems has shown that neither the liquid concentration nor the fissile loading of the solids received into the WTP will be increased to an unsafe condition. The maximum plutonium (Pu) concentration in the liquid is expected to be less than 2 % of the maximum safe subcritical Pu concentration. The Contract limit on Pu loading in the solids is only 26 % of the maximum safe subcritical Pu loading (DOE DE-AC27-01RV14136). Solids formed during precipitation of strontium/transuranic (Sr/TRU) will have a Mn to Pu ratio that conservatively exceeds the minimum safe subcritical Mn/Pu ratio.

Section 6.4.2, Criticality Safety Limits, describes the methodology for the criticality evaluations. Normal and off-normal/accident conditions are analyzed in the contingency analysis in section 6.4.5, Evaluation of Normal Conditions, and section 6.4.6, Application of Double Contingency Principle, respectively. Section 6.4.6 also documents the application of the double contingency principle for the WTP Project.

The controls relied on for criticality safety are the sampling and analysis of the incoming feed (section 6.4.3, Design Features and Justification for the Use of Administrative Controls, and section 6.4.4, WTP Criticality Safety Limits and Defense in Depth). With these controls a criticality accident is not credible in the WTP process facilities and a criticality accident alarm system is not needed (section 6.6, Criticality Instrumentation).

Open issues related to criticality evaluations are listed in CSER Appendix A, Action Items for Developing this CSER.

The CSP (section 6.5, Criticality Safety Program) is tailored appropriately to the criticality hazards identified during the design, construction, and commissioning phases of the WTP. The CSP will be maintained current and will be implemented through approved procedures throughout the lifetime of the WTP. The CSP implementation will be appropriate to each individual criticality evaluation while ensuring that the double contingency criterion is satisfied. This implementation considers normal and off-normal operational conditions, credible accident conditions, and significant changes to operations.

6.2 Requirements

Controls for the prevention of criticality will be in accordance with the following:

Safety Requirements Document, Section 3.3, Criticality, Safety Criteria 3.3-1 through 3.3-8

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 6
1.5	Criticality Safety	Chapter 6, "Criticality Safety Program"

Specific SRD implementing standards addressed in Chapter 6 include the following:

ANSI/ANS-8.1 *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactor*
ANSI/ANS-8.19 *Administrative Practices for Nuclear Criticality Safety*

Implementation of ANSI/ANS-8.1-1983 and ANSI/ANS-8.19-1996 are documented in Tables 6-1 and 6-2. (See SRD Volume II, section 3.3 for the revisions of these two codes to be implemented for the WTP, as they may be more recent that those in Tables 6-1 and 6-2.)

The following additional requirements are applied to the CSP:

- Operations involving the handling, processing and storage of fissionable material will be controlled by procedures that incorporate the requirements of the CSER and the CSP.
- During the design phase, criticality safety for proposed normal and off-normal operations and credible accident conditions will be demonstrated by appropriate analyses documented in the CSER.
- During fissile material operations, to protect against an uncontrolled nuclear criticality incident, nuclear criticality safety (NCS) considerations and controls will be evaluated for normal and off-normal operations and credible accident conditions before any significant operational changes are made. This evaluation will also address changing process conditions, hardware modifications and installations, human failures, and system reliability that could change the criticality safety basis. The evaluation will be documented in an approved CSER before handling fissionable material in the new or modified operation.
- The multiplication factor, k-effective (k_{eff}), including all biases and uncertainties at a 95 % confidence level, will be shown to not exceed 0.95 under all credible normal, off-normal, and upset conditions. All calculational methods will be validated and documented in accordance with section 4.3, Validation of a Calculational Model, of ANSI/ANS-8.1.

6.3 Summary of Criticality Safety for the WTP

The criticality safety of the WTP is established by having low fissile concentrations in the incoming liquid feed, low fissile loading in the incoming solids, and an adequate absorber-mass to Pu-mass ratio in the incoming solids (see section 6.4.2.2.1, Waste Fissionable Mass Parameterization, for the specific definition of F). These criticality safety parameters will be verified by sampling the incoming feed to the WTP. The controls imposed on feed sampling are discussed in section 6.4.4. The Contract limit on the Pu loading in the feed is only 26 % of the maximum safe subcritical Pu loading.

The best basis inventory information has been used to estimate the Pu loadings of the double-shell tanks (DST) while conservatively assuming that all Pu is in solid form. The estimated maximum Pu loading is 0.023 g Pu/100g_{wo}, which is only 38 wt% of the CSL of 0.06 g Pu/100g_{wo} of solids and only 11 wt% of the 0.205 g Pu/100g_{wo} maximum safe subcritical mass ratio. These comparisons indicate that it is improbable that the DSTs even hold waste exceeding the Pu Contract limits.

Regarding these loadings, because the water content of the solids may vary, the solids contents are parameterized in terms of loading. Specifically, these loadings are the nuclide or elemental mass per 100 g mass of equivalent, non-volatile waste oxides. In this chapter and the CSER, the nuclide or elemental loadings are denoted with the unit "g/100g_{wo}," but the alternative unit, "g/100g_{NVS}," is also used.

In addition, criticality has been shown to be not credible in the tank farms. The current criticality safety evaluation for tank farms allows tank-to-tank transfers and maintains that criticality is not credible during all tank farm operations (references in CSER). The transfer of waste from a DST to the WTP low-activity waste (LAW) or high-level waste (HLW) facility receipt vessels is the same type of tank-to-tank transfer allowed within the tank farms. Sampling of the waste to be transferred is not required before a tank-to-tank transfer within tank farms. However, for transfers to the WTP, the DST will be sampled before transfer, providing additional assurance that criticality is not credible in the WTP receipt vessel. Before processing the waste, samples are taken from the WTP receipt vessel to verify that the Pu concentration in the liquid and Pu loading in the solids are below Contract limits.

Two samples of the waste feed in the WTP receipt vessel are taken and analyzed before processing the feed (blending with other streams or sending the waste beyond the HLW or LAW feed receipt system). The WTP receipt vessels will contain pulse jet mixers and have an engineered automatic sampling system. The sampling process begins with loading an empty sample bottle into a sample carrier. The barcode on the sample bottle is read and recorded for tracking during the analysis phase. The sample carrier is then drawn by vacuum along pneumatic transport lines to the autosampler on the specified receipt vessel. The carrier is opened, the bottle is removed and placed on the needle of the autosampler, and the sample is drawn. Next, the sample bottle is returned to the sample carrier, pneumatically transported to the laboratory, and deposited into the hot cells. Only one sample carrier is in the system at a time. The sampling system is completely automated minimizing the possibility of a human failure in the sampling process. Verification that the sampling system obtains a representative sample will be performed before the receipt of fissile material. In addition, the sampling system will be designed to collect sufficient solids to analyze the Pu loading.

The samples will be analyzed for liquid Pu concentration and Pu loading in the solids. The samples will be analyzed by alpha spectroscopy and inductively coupled plasma/mass spectrometry. Different equipment and procedures will be used for the two methods, and the barcode on the bottle will be used to ensure that the correct sample is analyzed. The sample will be treated by a process that closely mimics the actual process steps through ultrafiltration and any intended leaching. The Pu liquid concentration and Pu solids loading in each sample will be analyzed at the 95 % confidence level at various stages through this process simulation. If the two samples disagree to the extent that suggests a failure (as defined in laboratory procedures), two additional samples will be taken from the receipt vessel and reanalyzed. When both samples are confirmed as meeting the CSLs (section 6.4.4), the feed can be processed through the WTP. If the sample results are to be input into a process control system, this input will be verified by a second person to ensure accurate transcription of the results.

The laboratory analysis of the WTP receipt vessel samples will be a technical safety requirement (TSR). The procedures that will serve to implement the TSR will involve the following:

- The two samples are analyzed by different laboratory technicians
- The laboratory equipment operation will be verified using a check source between analyses and the input of the sample result into the computer system
- If applicable, the laboratory equipment operation will be verified by a second individual

The procedures will not be developed until the facility is closer to operation, but will be reviewed to ensure that common mode failures are minimized or excluded. The use of two separate analysis methods with separate equipment and procedures also increases the reliability of the sampling regimen identified.

The feed is sampled in the DST before transfer by tank farm personnel and the results given to the WTP as discussed in 24590-WTP-ICD-MG-01-019, *Interface Control Document for Low-Activity Waste Feed*, and 24590-WTP-ICD-MG-01-020, *Interface Control Document, Interface Control Document for High-Level Waste Feed.* The sample results will be reviewed by the WTP to ensure compliance with Contract limits including the analysis of the Pu loading in the solids and the Pu concentration in the liquid. Due to the difficulty in taking a representative sample from a one million gallon DST and the possibility of a misroute of unsampled waste to the WTP, the sample from the DST is not relied on as an independent criticality safety control. However, this sample does provide defense in depth, as the liquid concentration and the solids loading in the sample will be analyzed.

Thus, considering the low fissile concentration in the liquid portion of the feed and the low fissile loading and large poison/Pu ratios in the solids (section 6.1), and the controls on sampling of the feed to ensure that feed will not exceed the Contract limits discussed in this section, it is concluded that criticality is not credible for the WTP.

6.4 Criticality Limits and Controls

6.4.1 General Control Principles

Where enough fissionable material is being processed that criticality safety is a concern, passive engineering controls, such as geometry control, are the preferred control method. Where passive engineered controls are not feasible, the preferred order of controls is active engineering controls followed by administrative controls. The double contingency analysis must justify the chosen controls. Full advantage may be taken of any nuclear characteristics of the process materials and equipment. The assumed geometry of the fissile-containing material is to be conservatively considered as water moderated and reflected unless it can be shown that the presence of water is not credible. All dimensions, nuclear properties, and other features of the fissile-containing material relied on for NCS reliance are documented and verified before beginning operations. Control will be exercised to maintain these assumptions.

Process and equipment design use the most positive practical method to prevent a criticality accident. As an example, the following methods are listed in order of decreasing safety assurance relative to the prevention of criticality:

- Worst-case characteristics of the process materials proven to remain less than minimum critical limits (passive engineered control)

- Geometrically safe equipment (passive engineered control)
- Fixed poisons (passive or active engineered control, depending on scenario)
- Instrumentation (active engineered control)
- Soluble poisons (active engineered control or administrative control, depending on scenario)
- Spacing between units of fissile material (passive engineered control or administrative control, depending on design/scenario)

Administrative controls are used as the primary control only when no practical design measure is available. When reliance on administrative controls cannot be eliminated, such controls are few, simple, internally consistent, and directly controllable. These controls must be adequately justified for deviation from the above control principles. Procedures will provide controls and appropriate verification of compliance.

All dimensions, nuclear related properties or other features upon which reliance is placed, as defined in a CSER, will be verified before beginning operations.

6.4.2 Criticality Safety Limits

In determining the need for criticality limits, the following quantities or forms of materials are exempt from criticality safety control:

- Fifteen grams or less of ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu and ^{241}Am or any fissionable nuclide with atomic number less than 96 (except ^{242m} Am).
- Two grams or less of any fissionable nuclide with atomic number greater than or equal to 96 or ^{242m} Am (^{242m}Am, ^{43}Cm, ^{244}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf, and ^{251}Cf).
- Depleted and natural uranium (U) in any amount.
- Uranium solutions, compounds and metal, if homogeneous (not latticed), enriched up to 1.0 % U^{235} or its nuclear equivalent.
- ^{237}Np, ^{238}Pu, ^{241}Am, and ^{244}Cm with $H/X > 5$ in any amount (H = atoms of hydrogen, X = atoms of fissionable material). The potential for changes in the H/X ratio due to errors or accidents, such as fire or evaporation, must be evaluated

6.4.2.1 Methodology

Computations using the Monte Carlo N-Particle Transport (MCNP) Code version 4C (CSER) were used for deriving CSLs 8.1.1 and 8.1.2 (section 6.4.4.1). CSLs 8.1.3 and 8.1.4 were derived from published criticality safety documents referenced in the CSER. The MCNP Code is widely accepted for criticality safety calculations and was used to calculate the effective multiplication factors (k_{eff}) for the high-level waste and the glass products. The distributed version of the MCNP Code has not been modified or extended for these computations. Control of the MCNP Code is in accordance with the WTP Quality Assurance Manual, Policy Q-03.2, Software Quality. This section summarizes the computational methodology of the MCNP Code and the verification and validation of that methodology. Additional detail is in CSER Chapter 4, Methodology.

In the "kcode" mode, MCNP tracks individual neutrons through a modeled geometry. This technique results in a calculated k_{eff} with an associated uncertainty expressed as a standard deviation (σ_c) for the calculation. As more neutrons are tracked, the standard deviation is reduced. The calculations modeled 5,000 neutron per generation for 120 generations. The first 20 generations are skipped in k_{eff} calculation to allow the neutron source to equilibrate. Sufficient neutrons are tracked to result in a low uncertainty, approximately 0.001 in k_{eff}.

The validation of MCNP 4C for criticality calculations was performed in and documented in accordance with ANS 8.1 section 4.3, Validation of a Calculational Method, and the WTP quality assurance program. A set of 30 experiments was chosen as representative of WTP waste and glass compositions and was modeled with MCNP. The fissile forms in these experiments included Pu solutions and Pu oxide (PuO_2) solids. Further discussions of the applicability of these experiments to the WTP waste are found in documents referenced in the CSER.

The bias and uncertainty of the code, as determined from a statistical analysis of the results of the critical experiments modeled, were also calculated. The uncertainty in the critical experiments was incorporated into the statistical determination of the bias and uncertainty. The code bias is b_b = -0.0096 and the uncertainty or standard deviation in the bias is σ_b = 0.0058.

The following statistical method was used to combine the code bias and the uncertainty with the MCNP k_{eff} and associated standard deviation at a 95 % confidence to produce a value termed $K_{95/95}$. This $K_{95/95}$ is dependent on the number of critical experiments modeled and the resulting code statistics in addition to the k_{eff} and standard deviation of the calculation.

$$K_{95/95} = k_{eff} + b_b + U_{crt}(\sigma_b^2 + \sigma_c^2)^{1/2}$$

where

σ_c = calculated standard deviation

b_b = benchmark set code bias

σ_b = benchmark set standard deviation

U_{crt} = uncertainty multiplier for the 95 % confidence level

The σ_c and σ_b standard deviations are combined as a sum of squares, as they result from independent events; σ_b is a function of the inaccuracies in modeling the critical experiments, and σ_c is a function of MCNP neutron histories. The uncertainty multiplier, U_{crt}, is a function of the number of degrees of freedom, df, of the sets of samples as determined by the following equation:

$$df = \frac{(\sigma_b^2 + \sigma_c^2)^2}{\frac{\sigma_b^4}{N_b + 1} + \frac{\sigma_c^4}{N_c + 1}} - 2$$

where:

df = number of degrees of freedom

N_b = number of benchmark experiments modeled

N_c = number of generations used to calculate the standard deviation of the MCNP calculation (i.e., 100)

The U_{crt} is found as a function of df from tables of one-sided tolerance limit factors for a normal distribution (CSER). The set of k_{eff}s calculated for the critical experiments was shown to be normally distributed (CSER) as required to use a U_{crt} value for a normal distribution. The U_{crt} that give a 95 % confidence level in the standard deviation and a 95 % confidence level in the mean are used.

The use of this statistical method allows the conclusion that 95 % of the normal population will be less than the $K_{95/95}$ value with 95 % confidence. The $K_{95/95}$ must be less than $k_{safe} = 0.95$ (SRD Safety Criterion 3.3-2).

Because the experiments modeled in determining the code bias and uncertainty are limited to having measured reactivities of $k_{eff} \approx 1.0$, it is not considered valid to extrapolate the $K_{95/95}$ analysis to calculated results with $k_{eff} < \sim 0.8$. Therefore, the $K_{95/95}$ analysis was not used when $k_{eff} < \sim 0.8$. Nonetheless, systems with $k_{eff} < 0.8$ are subcritical by sufficient margin so that explicit inclusion of the bias and bias uncertainty is unnecessary.

6.4.2.2 Analysis for WTP Criticality Safety Limits

This section describes the analysis used in the CSER for deriving the CSLs that ensure the safety of the WTP operations. The CSLs are provided in section 6.4.4. Section 6.4.2.2.1 discusses the means of parameterizing the fissile masses that create the potential for criticality in the waste. The solids contents of the HLW feed are described in section 6.4.2.2.2, Characterization of High-Level Waste Solids. The subsequent sections discuss the derivation of the CSLs, which differ fundamentally between the waste liquids and the waste solids and are discussed in detail in section 6.4.2.2.3, Limits for Waste Liquids, and section 6.4.2.2.4, Limits for Wastes Solids, respectively.

6.4.2.2.1 Waste Fissionable Mass Parameterization

The ^{235}U and ^{239}Pu fissile nuclides are the primary criticality concerns in the WTP waste. The ^{235}U is present because it was used as fuel and being in the target material of the Hanford reactors. Tank farm data show that, on average, the uranium is at $^{235}U/^{Total}U = 0.7$ wt% enrichment (slightly below that of natural uranium at 0.71 wt%, enrichment). The ^{239}Pu is present as a consequence of irradiating ^{238}U in the reactor Pu production campaigns. However, because the objective was to produce Pu, most of the Pu was recovered in separation processing, and only a small portion reached the waste tanks. Although ^{235}U and ^{239}Pu are the primary criticality concerns in the waste, other fissionable nuclides of criticality concern are also present. This section discusses the means of accounting for the fissionable nuclides.

The criticality safety of the ^{235}U nuclide is accounted for separately by considering that ^{235}U may be demonstrated adequately subcritical due to the absorption in the ^{238}U nuclide. All other fissionable nuclides in the waste are lumped with the fissile ^{239}Pu to be controlled by other means.

The CSL for controlling the reactivity of the ^{235}U is

CSL 8.1.3 All waste shall be sampled in the WTP receipt vessel after waste mixing, and shall have an absorber ratio, that is:

$$^{238}U \text{ mass}/^{235}U \text{ mass} > 110.$$

This CSL allows that the fissile ^{235}U may be considered subcritical due solely to the ^{238}U absorption. This absorber ratio limit of $^{238}U/^{235}U > 110$ is equivalent to an enrichment limit of 1/(110+1) = 0.90 wt%, which compares conservatively with the 0.96 wt% ^{235}U enrichment limit from the ANS 8.1. Because the CSL requiring that $^{238}U/^{235}U > 110$ is established based on an enrichment limit from ANS 8.1, there are no MCNP computations to establish the CSL. Note also that the $^{238}U/^{235}U$ absorber ratio does not apply to the ^{233}U nuclide.

The uranium in the waste tanks originates from fuel irradiated in the Hanford reactors. The maximum enrichment of the fresh fuel before loading to the reactors was 2.1 wt% ^{235}U, but most of the fresh fuel was either at the 0.71 wt% natural enrichment or enriched to only 0.95 to1.25 wt%. The reactor fuel was burned before reprocessing, which lowered the enrichment in the waste. Tank measurement data (section 6.4.2.2.3) show the tanks hold a 0.88 wt% maximum enrichment (equivalent to $^{238}U/^{235}U > 112$). Thus, all tank waste now scheduled for processing in the WTP is expected to meet the CSL that $^{238}U/^{235}U > 110$. The CSL ensures that the ^{235}U reactivity is controlled by absorption in ^{238}U, and makes it unnecessary to demonstrate that selective precipitation of uranium will not occur. Typically, criticality evaluations do not credit the depletion of fissile nuclides from reactor fuel. However, crediting the loss of reactivity due to ^{235}U depletion is appropriate because the absorber ratio in the waste will be directly measured by taking two independent samples for laboratory analysis, as detailed in section 6.3. There are no WTP processes capable of decreasing the $^{238}U/^{235}U$ absorber ratio in either the liquid or solid waste (that is, there are no processes for separating the ^{235}U and ^{238}U).

The ^{239}Pu is the other primary fissile nuclide of criticality concern in the waste. However, numerous other TRU nuclides are present in amounts that do not represent significant criticality concerns. These other TRU nuclides are lumped with the consideration of ^{239}Pu for purposes of analysis. The total fissionable mass (F) of these lumped nuclides is

$$F = {}^{233}U \text{ mass} + \text{total Pu mass}$$

The F mass represents an equivalent ^{239}Pu mass and is intended to account for all fissile and fissionable nuclides of criticality concern in the waste other than the ^{235}U, which is addressed with a separate CSL on $^{238}U/^{235}U$. The means by which the formula above for the F mass accounts for the various fissionable and fissile nuclides is discussed in detail in CSER section 5.1, Waste Fissionable Mass Parameterization.

6.4.2.2.2 Characterization of High-Level Waste Solids

This section provides characterization data of the expected HLW feed that consists of Envelope D solids in LAW Envelope A, B, or C solutions. This information illustrates the fissionable loadings and the absorber ratios, Fe/F, Mn/F, and Ni/F, that can be monitored as CSL parameters to ensure subcriticality under normal and upset conditions. The F mass parameter is defined in section 6.4.2.2.1. This section also describes the basis by which these ratios can be used to establish the CSLs.

The best estimates of Envelope D solids are presented in Table 6-3, Envelope D Characterization Data Significant to Criticality Safety, which gives the expected ratios as indicated above (CSER). Comparison of these ratios with the minimum mass ratios needed to demonstrate subcriticality shows the expected margins available in the various feed streams. In particular, Table 6-3 shows that the maximum fissionable loading is 0.0189 $gF/100g_{NVS}$, which compares to a subcritical limit of 0.205 $gF/100g_{wo}$ from Table 6-5.

Comparing the absorber ratios also shows margins of safety. The minimum absorber ratios to ensure subcriticality are Fe/F > 170, Mn/F > 35, and Ni/F > 65, as specified in CSL 8.1.4 (section 6.4.4). These absorber ratio limits are determined by infinite medium calculations that model only the absorber nuclide and ^{239}Pu. The addition of any other nuclides, even in small amounts, increases the absorber ratios, so the ratios provide a conservative control that ensures subcriticality. Comparing the absorber ratios in Table 6-3 with the corresponding CSLs demonstrates that Envelope D feed can be safely processed under normal and credible upset conditions.

In this connection, it is helpful to qualitatively review the expected processing that might change these ratios after initial acceptance of the feed. Processing by the evaporator drives off water, but leaves the solid loadings and absorber ratios essentially unchanged. Chemical processing by the addition of sodium permanganate, $Na(MnNO_4)$, will increase both the Mn and Fe in the solids (CSER) and will consequently increase these absorber ratios. The Fe/F ratio is increased because the sodium permanganate causes some Fe to precipitate from the liquid also.

Ultrafiltration by itself does not change these ratios, as the only activity in this step is an increase of the solids up to a desired fraction (about 20 %). Therefore, ultrafiltration has little effect on the loading or Fe/F, Mn/F, and Ni/F. Following ultrafiltration, the solids in the ultrafilter may be washed with demineralized water or a mild caustic solution to dissolve aluminum (Al), chlorine, chromium (Cr), fluorine, potassium (K), silicon (Si), sodium (Na) and other species of minor importance. This wash is expected to have minor effect on Fe, Mn, nickel (Ni), and Pu. A higher fraction of Pu is likely to dissolve than for Fe, Mn, and Ni. Therefore, although the wash step concentrates the Pu in the solids, the important ratios of Fe/F, Mn/F, and Ni/F remain unchanged or, if anything, increase slightly.

The effects of this wash have been computed using empirical wash factors to provide a qualitative picture of the expected Pu concentration increases. The expected Pu loading before the wash is given in Table 6-3 along with the computed concentration factor on the last line. These factors show that the wash is not normally expected to increase the Pu loading by more than a factor of about two. The CSLs require sampling to confirm the Pu loading and the Fe/F, Mn/F, and Ni/F absorber ratios in the incoming feed.

With use, the ultrafilters tubes may become plugged. If this condition occurs, the ultrafilters may be washed to leach solids into a nitric acid solution. During this wash, the absorbers (such as Fe, Mn, Ni, Cr, and P) will not preferentially dissolve away from the Pu. If anything, the Pu may dissolve into solution faster than the absorbers. Criticality safety is ensured at significantly higher absorber ratios than those imposed by the absorber ratio CSLs, because of the high water content of the solids. This is true during the normal operations before the transfer of the solids stream into the HLW melter. The solids are typically 60 and 70 wt% water up to this stage of processing, and the solids provide absorption that is not present in pure Pu and water mixtures. Therefore, the high water content of the solids limits reactivity for the normal conditions, except in the melter, melter glass, and offgas lines where the water is evaporated and subcriticality must be shown for essentially dry solids. The CSLs on Fe/F, Mn/F, Ni/F, and the Pu loading to ensure subcriticality for these normal conditions and for the upset conditions with dry solids.

Upset conditions detailed in the CSER include considerations of sludge dry-out, such as from a malfunction of an evaporator, tank rupture, or sludge on the bottom of a tank. In these situations, criticality safety relies on the Pu loading remaining below the SSL of 0.205 $gPu/100g_{wo}$ and the absorber ratio for Fe, Mn, or Ni being large enough to ensure subcriticality. The CSER shows that the Fe, Mn, or Ni absorbers are present in quantities sufficient to ensure subcriticality. As defense in depth, it has also been noted that sufficient Na is present to ensure subcriticality for all phases of waste processing for both the liquid and solids.

6.4.2.2.3 Limits for Waste Liquids

Within the waste liquids, criticality safety is provided by CLS on the fissile concentrations because only low fissile masses are dissolved within the liquids. Table 6-4, Low-Activity Waste Liquid Activities and Concentrations gives the maximum allowed TRU activities for the three low-activity waste liquid feed envelopes as allowed by the Contract limits. For conservatism in maximum ^{239}Pu concentrations and other parameters, the CSER assumed that all TRU nuclides are ^{239}Pu. With this assumption and using the maximum Na concentration from the allowed range (Table 6-4), a maximum allowed ^{239}Pu concentration of 0.013 gPu/L was calculated. As Table 6-4 shows, the Envelope C waste is limiting because it holds the highest TRU activity. Based on this analysis of the Contract limits, a criticality limit is established for the liquids, that is:

CSL 8.1.1 The liquids shall be sampled in the WTP receipt vessel after waste mixing and shall have an F Fissile Concentration < 0.026g F/L.

A margin for operational flexibility is established between the maximum fissionable concentration allowed by the Contract and the CSL. A safe subcriticality limit (SSL) concentration of 6.4 gPu/L was calculated for ^{239}Pu in water (CSER) at a calculated reactivity of $K_{95/95} = 0.9397$, which includes code bias and uncertainty for either Pu or PuO_2 in water. The reactivity of the actual waste will be lower because of Fe and other absorbers, whereas the calculation models only Pu and water. This model is applicable to both the low-activity waste feed, which contains few solids, and the low-activity waste permeate after ultrafiltration removes the solids. The calculated SSL concentration of 6.4 gPu/L for ^{239}Pu in water compares conservatively with the single parameter concentration limit of 7.3 g/L for a ^{239}Pu solution from ANS 8.1. The SSL is somewhat lower because of the various uncertainties accounted for in the calculation, as required to fulfil the SRD.

6.4.2.2.4 Limits for Waste Solids

Within the solids of the waste, the fissile concentrations are relatively low compared to subcritical limits that are often used for aqueous fissile solutions (ANS 8.1). During normal operations, these solids are suspended in a slurry that typically has a water content exceeding 60 wt%. The presence of this water provides a large margin of subcriticality for normal operations before the feed entering the melter. Nonetheless, the CSER concludes that limits on fissile concentration are not sufficient for providing the criticality safety for the solids. This is because of potential upset conditions where the solids may dry out or fissile concentrations may change by a factor of three or more. In these cases, the dilution of the fissile material by water alone may be insufficient for reactivity control. Therefore, the presence of other absorbing materials within the solid waste is credited for reactivity control. For the incoming solids, the nuclide loadings or mass fractions must be within the Contract limits. These nuclide loadings are parameterized with units "$g/100g_{wo}$." The analysis here and in CSER section 5.3.1, Limits for Waste Solids, describes how specific portions of these Contract limits are extracted to serve as CSLs on fissile loading for the incoming solids.

In addition to the fissile loading limits for the solids, other CSLs are developed here that apply to absorber to fissile material mass ratios. The analysis considers absorber ratios of Fe/F, Mn/F, and Ni/F. The CSLs are parameterized in terms of Fe/F and Mn/F, because these absorber ratios can generally be maintained as invariant within the solids processing. Specifically, the Fe/F, Mn/F, and Ni/F absorber ratios can be verified when the waste solids are received and the ratios will be invariant in the processing, if there are no chemical mechanisms to separate the Fe, Mn, and Ni from the Pu and U fissionable materials.

The absorber and fissionable nuclides might be separated by WTP processing. Several studies have considered the potential that nitric acid washes could separate the absorber and fissionable nuclides. Nitric acid will be used to clean plugged ultrafilter tubes (CSER section 6.4, Ultrafilters, for normal conditions; and section 7.4, Ultrafilters, for contingency conditions). Nitric acid will also be used to remove heels of settled solids from process vessels. A study was made by Pu chemists to determine the effects of low pH nitric acid on the Pu loadings in waste solids (CSER). The study included laboratory analysis of tank waste, characterization of samples analyzed with nitric acid, and a review of PUREX acidified sludge process experience. The study concluded that nitric acid will not selectively dissolve Fe from the waste solids to concentrate the Pu, and also concluded that Pu dissolves at a rate similar to that for Fe, Mn, Cr, or Si, for example, so that the Pu loading in the solid decreases. The only exception was Al, which may completely dissolve while the Pu remains in the solid.

Subcriticality is maintained in the liquid phase, even if nitric acid dissolves all Pu from the solids, because Fe and other absorbers dissolve into the liquid along with the Pu. Analysis (CSER) has not identified any sludge in which the Pu dissolves selectively over the neutron absorbers. A literature review also found that:

> "Ferric iron and Pu(IV) have similar solubilities in weak nitric acid solution, and would not be separately dissolved over the pH range 0 to 4. Uranium and manganese would be soluble throughout the same range."

Criticality Safety Evaluation for the Defense Waste Processing Facility (DWPF) at Savannah River Site (CSER) analyzed cleaning operations with nitric acid and upsets of sludge solids entering acidic systems. The DWPF evaluation affirms the safe use of nitric acid as a cleaning agent for reasons similar to those found in other studies. These studies indicate that subcriticality will also be maintained even during nitric acid cleaning operations by CSL 8.1.2 requiring that

> "The solids shall be sampled in the WTP receipt vessel after waste mixing, and shall have an F Fissionable Loading < 0.06 $gF/100g_{wo}$."

Table 6-5, High-Level Waste Solids Activities and Loadings gives the maximum activities and loadings allowed in the high-level waste solids feed by the Contract for those nuclides included in the MCNP modeling of the CSER. The specific loadings used for the MCNP models are included in the two right-most columns of the table. The maximum loadings allowed by the Contract limits in the table for the Pu and uranium nuclides are derived using the corresponding activities at the left of the table.

6.4.2.2.5 MCNP Models

Maximum safe subcritical Pu loadings have been calculated and documented in the CSER for various compositions of the waste solids. A Conservative Waste Model (CWM) was developed for Hanford tank farms analysis (reference in CSER) that use the nuclide loadings in Table 6-5 for the solids phase of the waste. This CWM uses infinite geometry in MCNP calculations and yielded a maximum safe subcritical loading of 0.210 $gF/100g_{wo}$ at a reactivity limit of $K_{95/95} \leq k_{safe} = 0.95$. Note that in Table 6-5, the Pu is considered additive with the other CWM nuclides. The CWM was validated by computational comparisons with sample data from 26 single-shell tanks in the tank farms (reference in CSER). The results show that the CWM gave higher calculated reactivity than using data from any of 26 actual waste samples.

The WTP Contract limits for the waste solids differ somewhat from the CWM composition that was developed earlier. Therefore, a new Contract model (CtM) was developed based on the WTP Contract feed specifications listed in Table 6-5. Parametric studies were performed for each nuclide in the old CWM to determine the reactivity effects. Nuclides that increased k_{eff} were maximized within the limits of the Contract feed specifications (Table 6-5) while nuclides that decreased k_{eff} were minimized. This methodology ensures that the CtM is more conservative than the CWM. The CtM yields a fissionable loading limit of 0.205 gF/100g_{wo} at the $K_{95/95} = 0.9465 \leq k_{safe}$ reactivity limit. This 0.205 gF/100g_{wo} loading is the primary SSL for the waste solids used in the CSER. The CSLs are conservatively established at lower values than the SSLs. The CSL correspond to the 0.205 gF/100g_{wo} SSL is:

CSL 8.1.2 The solids shall be sampled in the WTP receipt vessel after waste mixing, and shall have an F Fissionable Loading < 0.06 gF/100g_{wo}.

Table 6-5 compares the old CWM and new CtM and shows the Si loading is significantly higher in the CtM. This higher Si was incorporated by completely replacing the Al with Si. A parametric study showed the removal of Al had minimal reactivity effect. In addition, some Al species are highly soluble and may wash from the solid during process steps. For this and other reasons, Al is not included in the CtM, as Table 6-5 shows.

The expected feed from the Phase 1 DSTs was also evaluated in the CSER. This evaluation showed that the Al loading is similar to that of the CWM, the Si loading is significantly less than the Contract limit, and that there is a significant zirconium (Zr) loading in several tanks. However, the maximum safe subcritical loading of 0.205 gF/100g_{wo} is bounding. However, as indicated above, further analysis will be needed to verify the adequacy of the CtM. Completion of this analysis is being tracked as detailed in CSER Appendix A.

6.4.3 Design Features and Justification for the Use of Administrative Controls

SRD Safety Criterion 3.3-4 requires that design features or passive engineered controls such as geometry control be considered the preferred control method where enough fissionable material is being processed that criticality safety is a concern. The use of geometry control (for instance, using vessels with a diameter less than the minimum critical diameter) is not practical for the WTP because millions of gallons of waste cannot be effectively processed in small-diameter, geometrically safe vessels. For the WTP, the concentrations and loadings of fissionable materials in the process streams are sufficiently low that criticality safety can be ensured and criticality will not occur.

The CSLs in section 6.4.4 rely on sampling (section 6.3) and analysis of the waste feed to ensure that criticality will not occur. Sampling controls are generally considered administrative controls. However, the sampling system in the WTP is a fully automated engineered system for acquiring a representative sample without human intervention. In addition, Safety Criterion 3.3-4 allows that full advantage may be taken of any nuclear characteristics of the process materials and equipment. In this regard, the Pu concentration in the liquid and the Pu loading in the solids are low and have Contract limits that are conservatively far below the safe subcritical limits. The sampling is used to verify this low fissile composition of the feed.

The CSER shows that the WTP systems and processes will be maintained subcritical by implementation of the CSLs in section 6.4.4.

6.4.4 WTP Criticality Safety Limits and Defense in Depth

6.4.4.1 Criticality Safety Limits

The WTP CSLs follow and are included as draft TSRs. Further clarification of CSL implementation and bases is provided after the CSL.

CSL 8.1.1 The liquids shall be sampled in the WTP receipt vessel after waste mixing, and shall have an F Fissile Concentration < 0.026 gF/L.

In applying the CSLs the F is the total fissionable mass of criticality concern and is determined, as detailed in section 6.4.2.2.1, by the equation:

$$F = {}^{233}U \text{ mass} + \text{total Pu mass}$$

This CSL on concentration is to ensure that samples of the waste are checked before any waste is transferred into the WTP. The CSL is established at ~200 % of the 0.013 g/L WTP contract limit for ^{239}Pu. This allowance is made so that minor processing upsets (such as having non-representative tank farm samples) that lead to higher than expected concentrations, yet are not criticality concerns, need not be identified as CSL violations.

CSL 8.1.2 The solids shall be sampled in the WTP receipt vessel after waste mixing, and shall have an F Fissionable Loading < 0.06 gF/100g_{wo}.

This CSL on loading is established at ~110 % of the 0.054 g/100g_{wo} Contract limit for ^{239}Pu so that minor processing upsets that lead to higher than expected loadings, yet are not criticality concerns, need not be identified as CSL violations. This sampling applies to each batch volume transferred into the vessels.

CSL 8.1.3 All waste shall be sampled in the WTP receipt vessel after waste mixing, and shall have an absorber ratio that is:

$$^{238}U \text{ mass} / {}^{235}U \text{ mass} > 110$$

This absorber ratio CSL of $^{238}U/^{235}U > 110$ is equivalent to an enrichment limit of 1/(110+1) = 0.90 wt%, which compares conservatively with the 0.96 wt% ^{235}U enrichment limit from ANS 8.1 for uranium oxides.

CSL 8.1.4 All waste shall be sampled in the WTP receipt vessel after waste mixing, and shall have an absorber ratio that is

Fe mass/F mass > 170, or
Mn mass/F mass > 35, or
Ni mass/F mass > 65

The absorber ratio requirements in this CSL are established as slightly more conservative than calculated SSLs.

All analyses of waste samples from the WTP receipt vessel for the above CSLs shall use two samples that shall be independently analyzed to demonstrate compliance with the CSLs.

All determinations of fissionable and absorber masses from sample analysis for the above CSLs, shall appropriately account for measurement uncertainties, at a 95 % confidence level.

The waste shall not be processed until the sampling regimen demonstrates that the waste meets the CSLs. The sampling regimen shall include

- Comparisons of results from the two independent samples. If these comparisons show disagreement or inconsistency that suggests an analysis failure, as defined in laboratory procedures, two additional samples shall be taken and reanalyzed.
- Testing to show that all samples are representative of the waste in the vessels.
- Provisions that two different laboratory technicians independently analyze the two samples.
- Provisions that if sample results are manually input to a computer, a second technician shall independent verify the input.
- Verification of laboratory equipment operation by use of a check source or other method before each sample analysis.
- Bottle bar-coding to ensure the correct sample is analyzed.

6.4.4.2 Limits for Defense in Depth

The Defense in Depth Limits (DDLs) in this section are considered as defense in depth aspects of the CSP. As such, these DDLs are to be implemented in procedures as administrative controls, but not in the TSRs.

DDL 8.2.1 Before liquids are received into the WTP, sample results from the Tank Farms shall demonstrate that the waste has an F Fissionable Concentration < 0.026 gF/L.

DDL 8.2.2 Before solids are received into the WTP, sample results from the Tank Farms shall demonstrate that the waste has an F Fissionable Loading < 0.06 gF/100g_{wo}.

6.4.5 Evaluation of Normal Conditions

Criticality hazards during normal operation were identified by considering the components in the WTP that have the potential for concentrating fissile material in the HLW, LAW, and Pretreatment facility (such as feed receipt, ultrafiltration, evaporation, Sr/TRU precipitation, Cs and Tc ion exchange, and lag and product storage). The components identified and evaluated are discussed in CSER Chapter 6, Evaluation of Normal Conditions. The potential for criticality in these components was then addressed. The significant margin between the calculated fissile loading in the component and the maximum safe subcritical Pu concentration showed the conclusion that over a wide variation in process parameters, criticality was not credible.

6.4.6 Application of Double Contingency Principle

SRD Safety Criterion 3.3-3 states that

> "Process designs shall incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. Protection shall be provided by either: (1) the control of two independent process parameters [which is the preferred approach, when practical, to prevent common-mode failure], or (2) a system of multiple controls on a single parameter."

The number of controls required for a single controlled process parameter is based on control reliability and any features that mitigate the consequences of control failure. In all cases, no single credible event or failure will result in the potential for a criticality accident.

Engineering judgment is used in determining whether two events are related and consequently, whether they represent two contingencies or a single contingency. For example, exceeding storage limits and then flooding an area would constitute two independent events. However, fire and flooding resulting in the actuation of an automatic sprinkler system would be considered a single event. Anticipated or expected events are not considered contingencies, but are analyzed as part of the base condition or as part of a single contingency based on multiple errors.

CSER Chapter 7, "Evaluation of Contingent Conditions," addresses the credible contingencies and demonstrates that criticality is not credible under each scenario. Thus, the intent of the double contingency principle is met, as it was shown that a criticality was not credible for all of the contingencies.

6.4.6.1 Contingency Analyses

CSER Chapter 7 addresses the upset or contingent conditions for WTP operations and demonstrates that criticality is incredible for each contingent condition. Table 6-6, Summary of Contingent Conditions (of this PSAR chapter) summarizes the contingent conditions for WTP operations discussed in CSER Chapter 7. The CSER contains references to the source of the data and analyses conclusions presented below.

The following summarizes contingency analyses of particular importance to the WTP.

<u>Contingency 7.1.1, WTP Feed Fissile Has High Fissionable Concentrations or Loadings.</u> The CSER provides the following summary relative to this event:

- Two samples will be taken from the WTP receipt vessels and analyzed for Pu loading in the solids and Pu concentration in the liquid at the 95 % confidence level to confirm the CSLs.
- One sample will be analyzed using alpha spectroscopy and the second sample will be analyzed using inductively coupled plasma/ mass spectroscopy resulting in independence of the sample analyses for CSL confirmation and reducing the potential for common-mode failures.
- The waste is sampled from the tank farms tanks before transfer to the WTP to confirm the DDLs.
- It will be shown that the sampling system takes a representative sample from the receipt vessels before receipt of fissionable material.
- The WTP sampling system is automated to minimize human failures in the sampling.
- Controls will ensure that the waste is not processed until it is verified that the sample results are within the CSLs and DLLs.

Thus, it is not credible that waste will be processed in the WTP that exceeds the Contract limits. Section 6.3, Summary of Criticality Safety for the WTP, provides additional details on these bulleted items.

Criticality is also not credible in the WTP receipt vessels because it is not credible in the tank farms, and the waste in the receipt vessel is identical to the waste in the tank farms. The best basis inventory and the sample taken from the DST further confirm that criticality is not credible in the WTP receipt vessel.

Contingency 7.1.2, Waste Stream Mixing. Subcriticality of the waste streams is ensured because of low Pu concentrations in the liquid waste and controlled Fe/F absorber ratios in the solid wastes. Mixing of fissile liquid streams will always produce a lower concentration than the highest of the input streams that are mixed. Similarly, when multiple solid batches are mixed, the Pu loading will not exceed the highest loading of the streams being mixed. Therefore, stream mixing cannot lead to criticality, if all mixed streams are already within the CSLs.

The chemistry of the mixing streams could precipitate solids, so tests were performed to assess the potential effects. Tank AW-101 waste was mixed with the solution obtained from washing entrained solids from the same tank, but no solids precipitated. However, when Tank AN-107 waste was mixed with the solution from washing entrained solids from the same tank, solids precipitated. Two tests were performed with this waste. In both cases, the mixed solution was cloudy immediately after mixing and a dark solid settled in the sample vials after 3 days. In the first test, 0.12 g of solids precipitated from a mixture of 15 ml of tank waste and 2 ml of wash solution. In the second test, 0.12 g precipitated from a mixture of 7 ml of tank waste and 2 ml of wash solution. Thus, 0.017 and 0.011 g solids/ml were in the tank waste solutions in the first and second tests, respectively. If the solution is at the WTP Contract limit of 0.013 gPu/L concentration, the Pu loading in the precipitated solids will be 0.075 or 0.115 $gPu/100g_{wo}$ using these test results. This assumes all TRU allowed within the WTP Contract limits is ^{239}Pu. Even with this conservatism, the Pu loading of the precipitated solids is less than the 0.205 $gPu/100g_{wo}$ SSL. Thus, based on these two samples, criticality cannot result from mixing fissile streams, even if solids precipitate. An action item to further develop this contingency is listed in CSER Appendix A.

Contingency 7.1.3, Fissile Solids Settle in a Vessel. The waste is staged in a number of vessels throughout the WTP. If solids accumulate and settle in the bottom of a vessel, the system will remain safely subcritical based on the high absorber/Pu ratios and the low fissile loading in the solids. The absorber ratios will comply with CSL 8.1.4 and the maximum Pu loading in the solids will be less than 0.06 $gPu/100g_{wo}$ as required by CSL 8.1.2. Vessel mixing and agitation systems are not needed because criticality cannot occur in the settled solids, if the CSLs are met. The sampling regime and CSLs are sufficiently robust to ensure that criticality is not credible. Therefore, the double contingency principle is fulfilled.

Preferential settling of solids containing high Pu also does not credibly lead to criticality. Analysis found that segregation of any given chemical specie from the remainder of the sludge, due to hydrodynamic action, is highly unlikely. The tank farms safety analysis also concludes that settling would not result in sufficient segregation of Pu-rich particles because

- A review of the mining literature indicates that gravity separation of Pu from tank sludge is improbable.
- Small particulates are expected to be flocculates, so that the Pu particles do not have different settling characteristics than other sludge.

The tank farms SAR states that segregation that may occur between faster- and slower-settling agglomerates will not change the Pu loadings in the sludge. In addition, a one-dimensional solids settling analysis was performed to determine the degree of segregation that may occur from settling solids under stagnant conditions. The study concluded that criticality is not possible due to solids settling because

- Solids settle in layers that are not pure Pu and a single layer containing sufficient Pu to support criticality is not plausible.
- The high Pu concentrations required for criticality in spheres or slabs are not plausible.
- The potential for creating substantial amounts of uniform-diameter pure Pu particles is very remote.
- Where Pu is bound to neutron absorbers through sorption or solids solution mechanisms, this binding would provide an additional barrier to segregation.

Contingency 7.1.4, Vessel Backwash with > 2 Molar Nitric Acid. An analysis concluded that criticality is not credible when adding nitric acid to tank waste. The Fe, Mn, Cr, and P, for example, in the solids are not preferentially dissolved away from the Pu but instead dissolve, like the Pu, to 90 % or greater in ~2 molar HNO_3. Adding nitric acid with a higher molarity may increase the dissolved percentage to 100 %, but will not preferentially dissolve the waste oxides to increase the Pu loading above the subcritical safety limit.

6.5 Criticality Safety Program

A Criticality Safety Program Plan has been prepared that provides an overall description of a CSP that implements the applicable requirements of section 4.2.2.5, Criticality, of *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor* (DOE/RL-96-0006). This section states that "The facility should be designed and operated in a manner that prevents nuclear criticality." The CSP Plan also implements safety criteria and implementing standards identified in SRD section 3.3, Criticality.

The CSP Plan and the content of this section are applied to

- The processes in the WTP project that have the potential to contain fissile material
- The operating, maintenance, and technical personnel that might be involved with these processes
- The administrative controls (for example, procedures, training, and change control) that support NCS

The CSP Plan will be maintained current and will be implemented through approved procedures over the life of the WTP facility. Implementation of the CSP Plan will be tailored to a level appropriate to each individual criticality evaluation while ensuring that the double contingency criterion is satisfied.

6.5.1 Criticality Safety Organization

This section describes the roles within the WTP for criticality safety. The interfaces of the organizations described below are discussed in Chapter 17 of 24590-WTP-PSAR-ESH-01-001-01, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information.*

6.5.1.1 Operations Manager

The roles of the operations manager relative to criticality safety include the following:

- Clearly establish responsibility and commensurate authority for NCS throughout the operations organization.
- Make it clear that maintaining criticality safety and the infrastructure to carry it out is the responsibility of each individual in their work area.
- Ensure that proposed processes or equipment involving fissionable material are not changed outside the approved safety basis envelope without a prior independent criticality safety review.
- Ensure that approved CSER and operating procedures are in place, the necessary controls required for criticality safety are implemented, and the operations personnel involved have been appropriately trained and made aware of NCS before fissionable material handling is permitted in a new or modified operation.
- Before the start of operations, ensure that written procedures for normal and off-normal operational conditions involving the processing, handling, storing, and transporting of fissionable materials are prepared, approved, and implemented. This implementation includes training of operating personnel on these procedures.
- Ensure that each person selected for handling or supervising the handling of fissionable material has the required qualifications to carry out assigned responsibilities, receives criticality safety and emergency procedure training, has a medical clearance, and is a certified fissionable material handler.

6.5.1.2 Environmental, Safety, and Health Manager

The roles of the Environmental, Safety, and Health (ES&H) manager relative to criticality safety are to

- Execute delegated authority from the project manager for overall safety of operations and establish responsibility for NCS throughout the WTP.
- Establish and maintain controls needed to ensure that material specifications for proposed feed to the facility are fully compatible with the process and are within the fissile material content bounds of the criticality assessments.
- Direct the development of appropriate CSER to support the design of all proposed operations involving the processing, storing, handling and transporting of fissionable material in greater than exempt quantities. The report should describe the validation of calculational methods with sufficient detail, clarity, and lack of ambiguity to allow for independent duplication of the results.
- Ensure that proposed facility designs, design modifications and process changes are reviewed and approved in accordance with the requirements of this program.
- Ensure that criticality safety analyses are performed and reviewed by suitably qualified and experienced people.
- Ensure that fissile material operations are subject to at least an annual review by individuals knowledgeable in criticality safety and who, to the extent practical, are independent of operations. The review will be conducted in consultation with operating personnel. The review will determine if procedures are being followed and will confirm that the criticality safety evaluation represents the current design and operation of the WTP.

- Ensure that written procedures and instructions are prepared, reviewed, issued, implemented and revised to describe the CSP process and requirements during design, construction, and commissioning. This implementation includes training of personnel on these procedures.
- During fissile material operation, ensure that procedures are developed and implemented for periodic internal inspections and management assessments of sufficient depth to validate that the facility is following the requirements of the criticality safety program.
- Ensure that a qualified NCS staff is available to support all activities related to criticality safety.
- Continue WTP project participation with national and international organizations for criticality related issues.

6.5.1.3 Radiological Safety Manager

The roles of the radiological safety manager relative to criticality safety are to

- Implement and maintain the criticality safety program during design, construction, and commissioning of the WTP Facility and inform WTP employees involved in operations with fissile material of the program.
- Appoint a criticality safety specialist (CSS) independent of operations who is familiar with the physics of nuclear criticality and associated safety practices to coordinate the development and implementation of CSLs and controls.
- Ensure that validated calculational methods for performing criticality safety analyses and the results of the analyses are maintained in accordance with the quality assurance and configuration management programs.

6.5.1.4 Criticality Safety Specialist

The CSS appointed by the radiological safety manager has the following roles:

- Before a new operation with fissionable material is begun or before an existing operation is changed, prepare a CSER. Determine the normal operating conditions and set of credible errors, operating errors, or failures affecting NCS. Establish appropriate process controls and limits to control normal operations and mitigate the consequences of failures. The CSS documents this evaluation in a CSER.
- Assist in the preparation of those sections of safety analysis reports dealing with criticality safety.
- Review procurement specifications for equipment with criticality safety requirements to ensure that the criticality safety controls and limits are incorporated.
- Provide technical guidance for the design of equipment and processes that involve fissionable material. Provide independent NCS review, analysis and approval of the design or modification of fissionable material processes, systems, and equipment. Ensure that the design features with criticality safety functions are identified that require verification by a facility quality assurance representative in accordance with the quality assurance program. This includes all equipment and systems whose performance affects NCS such as fire sprinkler systems in areas containing fissionable materials and process instruments that indicate or control fissionable material operating parameters.
- Review and concur with all facility procedures that implement criticality safety requirements for handling, processing, storing, or transporting fissionable material.

- Perform internal criticality safety inspections, implement corrective actions for identified deficiencies. Document the results of internal inspections and corrective actions.
- Assist or lead investigation team for control/limit violations. Develop control/limit infraction and violation recovery plans, as necessary.
- Conduct or participate in audits of criticality safety practices and procedure compliance.
- Examine reports of procedural violations, control/limit violations, and other deficiencies related to criticality safety for possible improvement of practices and procedure. Implement the corrective actions.
- Assist the ES&H manager by serving as liaison with emergency preparedness and other organizations on technical criticality safety matters.
- Advise personnel on questions concerning conformance to criticality safety requirements and the need to consult the appropriate facility safety representative for approval of any changes during operations.
- Inform the operations manager if any criticality related changes are discovered in the facility, including those that affect the pre-fire plans.
- Be the subject matter expert and provide technical assistance to the training organization to ensure that personnel are provided with criticality training appropriate for their assigned responsibilities. Prepare or review criticality safety training courses and examinations.
- Maintain technical skills in criticality physics. Track developments in analytical methods, computer codes, and applicable criteria. Maintain familiarity with the WTP facility and the controls and limits established for the prevention of a nuclear criticality.
- Request assistance when needed on criticality safety matters.

The CSS may be assigned other roles not related to NCS.

6.5.1.5 Project Safety Committee

The responsibilities of the Project Safety Committee relative to criticality safety are to

- Review and approve CSER.
- Review and approve modifications to the Preliminary and Final Safety Analysis Reports involving or impacting criticality safety. This includes criticality safety related unreviewed safety question determinations.
- Provide an annual independent review of the CSP. This can be accomplished by reviewing a report or presentation by the Radiological Safety Organization describing the status of the CSP. Areas of interest should include all criticality related incidents, causes or root causes, lessons learned, trends, assessment findings, and changes to any criticality limits and controls.

6.5.2 Criticality Safety Evaluations

A CSER has been prepared that documents that the entire WTP waste treatment process will be subcritical under both normal and off-normal operational and credible accident conditions. The bounding scenarios and required limits and controls are summarized in section 6.4. The CSER was independently reviewed by a second CSS to confirm the technical adequacy of the evaluation and was approved by the Project Safety Committee.

Before the start of a new operation or the change of an existing operation outside the scope of the approved CSER, a criticality safety evaluation will be performed and documented. This evaluation will show that the entire process will be subcritical under both normal and credible accident conditions. A CSER will document the evaluation with sufficient detail, clarity, and lack of ambiguity to allow independent judgment of the results. A CSER will also explicitly identify the controlled parameters and associated limits upon which criticality safety depends. The effect of changes in these parameters, or in the conditions to which they apply, will be understood. When specific parameters of equipment are relied on, such as the diameter for geometry control, this equipment and the specified parameter will be explicitly noted in the CSER to ensure proper verification before use. If reliance is placed on neutron-absorbing materials, control will be exercised to maintain their intended distributions and concentrations.

6.5.3 Criticality Safety Plans and Procedures

Before commissioning, the CSER limits and controls are implemented in written operating procedures that provide step-by-step instructions for fissionable material handling operations. They also include criticality safety warnings and cautions as appropriate. The following applies to procedures for criticality safety:

- All operations pertinent to criticality safety, including maintaining controls and limits important to criticality safety, will be governed by written procedures.
- All persons participating in these operations pertinent to criticality safety will understand and be familiar with the procedures.
- All new or revised procedures will specify all parameters they are intended to control.
- Operating procedures are prepared in accordance with approved procedure control programs.
- Maintenance of these procedures to reflect changes in operations will be a continuing supervisory responsibility.
- Operating procedures will be written so no single, inadvertent failure to follow a procedure can cause a criticality accident.
- Procedures will be organized and presented for convenient use by operators. Procedures will be free of any extraneous material.
- Active procedures will be reviewed periodically by the radiological safety manager.
- New or revised procedures that impact criticality safety will be reviewed and approved by the CSS before they are used.

Where operating procedures are significant to criticality safety, criticality safety postings will be used to provide the operator with a ready reference to CSLs or controls that are under the operator's control or observation. The posting is not meant to repeat all the information in the procedure but to provide the operators with simple, clear reminders of important criticality safety controls or limits.

6.5.4 Criticality Safety Training and Qualifications

The training program is tailored to job responsibilities, supports the conduct of the job, and meets the following objectives:

- Promotes understanding that criticality safety is the responsibility of the individual employee
- Raises the awareness of criticality safety issues in design and operations personnel
- Ensures that the CSS and assessors are suitably qualified and experienced to provide advice on criticality safety

The CSS will, at a minimum, meet the following qualifications:

1 Bachelor of Science degree in nuclear engineering, physics or related field
2 Three years of criticality safety experience, which includes
   - performing and documenting NCS evaluations
   - familiarity with critical and subcritical experiments
   - interfacing with operations staff commensurate with the expectations for the applicable project phase (for example, design and commissioning)
3 Six months of WTP experience to become familiar with the WTP systems and processes and the CSLs and controls

If the requirements of item 2 are not met, a training and qualification program commensurate with that in DOE-STD-1135-99, *Guidance for Nuclear Criticality Safety Engineer Training and Qualification*, will be implemented. If the requirements of items 2 or 3 are not met, the CSS will work under the supervision of an individual who meets the minimum qualifications, such as another CSS or the radiological safety manager. Documentation that an individual meets the CSS qualifications will be generated.

6.5.5 Criticality Safety Inspections and Audits

The WTP inspection, assessment, and audit programs are described in policies Q-10.1, Inspection; Q-18.1, Quality Assurance Assessment (Audit); and Q-18.3, Management Assessment, of 24590-WTP-QAM-QA-01-001, *Quality Assurance Manual*. Sections 6.5.1.2 and 6.5.1.4 address audits specific to criticality safety.

6.5.6 Criticality Infraction Reporting and Follow-up

Deviations from operating procedures and unforeseen alterations in process conditions that affect criticality safety are immediately reported to management and the CSS without disturbing the material or process in any way. The CSS leads an investigative team that is composed of, at a minimum, the operations manager and operations personnel familiar with the operation in question. The team develops a recovery plan for safely returning to compliance with the procedures. The deviation is corrected per the recovery plan, and the incident documented. Action will be taken to ensure that a similar situation does not exist in another portion of the facility and to prevent a recurrence.

In addition to the above activities completed in response to an infraction, a deficiency report is completed. It is determined if the infraction represents a condition adverse to quality or a significant condition adverse to quality. A significant condition adverse to quality includes infractions, if uncorrected, that could have a serious effect on safety. Such events require the determination of the need for a stop work order and the completion of a root cause analysis.

External reporting of criticality infractions will be implemented in the WTP occurrence reporting process (section 17.4.7, Occurrence Reporting, of 24590-WTP-PSAR-ESH-01-001-01 *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information*).

6.6 Criticality Instrumentation

SRD Safety Criterion 3.3-6 states that a criticality alarm system or criticality detection system is not required in locations where the probability of a criticality is determined to be less than 10^{-6}/yr, even if those locations exceed certain fissile inventories. The criterion also notes that the frequency of 10^{-6}/yr does not require that a probabilistic risk assessment be performed. ANSI/ANS-8.3 also indicates that a criticality alarm system is not required where no excessive exposure to personnel is credible. It should be noted that all WTP waste processing operations are conducted behind shield walls that reduce the radiation exposure to personnel. These walls are also sufficiently thick to prevent excessive (life threatening) exposure from a criticality.

Reasonable grounds for incredibility may be presented based on commonly accepted engineering judgement. Section 6.4 and the CSER have shown that processing out-of-specification waste is the only contingency that could result in a criticality. However, the criticality due to this contingency is not credible (section 6.3, Summary of Criticality Safety for the WTP, and section 6.4, Criticality Limits and Controls). Thus, neither a criticality alarm system nor a criticality detection system is required.

6.7 References

Project Documents

24590-WTP-ICD-MG-01-019, *Interface Control Document for Low-Activity Waste Feed.*

24590-WTP-ICD-MG-01-020, *Interface Control Document for High-Level Waste Feed.*

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan.*

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

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

24590-WTP-QAM-QA-01-0001, *Quality Assurance Manual.*

24590-WTP-RPP-NS-01-001, *WTP Criticality Safety Evaluation Report.*

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document Volume II.*

Codes and Standards

ANSI/ANS-8.1. *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* American Nuclear Society, La Grange Park, Illinois.

ANSI/ANS-8. *Criticality Accident Alarm System.* American Nuclear Society, La Grange Park, Illinois.

ANSI/ANS-8.19. *Administrative Practices for Nuclear Criticality Safety.* American Nuclear Society, La Grange Park, Illinois.

DOE/RL-96-0006. *Top-Level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.* US Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-1135-99. *Guidance for Nuclear Criticality Safety Engineer Training and Qualification.* US Department of Energy, Washington, DC.

Other Documents

DOE Contract Number DE-AC27-01RV14136. *Design, Construction, and Commissioning of the Hanford Tank Waste Treatment and Immobilization Plant,* US Department of Energy, Office of River Protection, Richland, Washington.

Table 6-1 ANSI/ANS-8.1-1983, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, Implementation Matrix

ANSI/ANS-8.1-1983[a] section	PSAR or CSER section that Implements Requirement[b]
1 Introduction	No requirements in this section.
2 Scope	No requirements in this section.
3 Definitions	No requirements in this section.
4 Nuclear Criticality Safety Practices	No requirements - see subsections.
4.1 Administrative Practices	No requirements - see subsections.
4.1.1 Responsibilities	
Establish responsibility for NCS, workers be aware of NCS.	Section 17.3.2, Organizational Responsibilities, states that line management is responsible for developing and implementing the safety basis and that line management's responsibility for safety may not be delegated. Section 6.5.1.3, Radiological Safety Manager, states that the Radiological Safety Manager informs WTP employees involved in operations with fissile material of the CSP. Section 6.5.4, Criticality Safety Training and Qualifications, discusses the training for individuals involved in NCS.
Provide personnel skilled in NCS that understand the process and to the extent practical are independent of operation.	Section 6.5.1.4, Criticality Safety Specialist, states that a role of the CSS, is to provide technical guidance for the design of equipment and processes that involve fissionable material and provide independent NCS review, analysis and approval of the design or modification of fissionable material processes, systems, and equipment. Section 6.5.1.3, Radiological Safety Manager, states that a role of the radiological safety manager relative to criticality safety is to appoint a CSS independent of operations
Provide criteria to be satisfied by NCS controls; may distinguish between shielded and unshielded.	Section 6.2, Requirements, and section 6.4.1, General Control Principles, provide the criteria to be applied to criticality controls for the WTP

Table 6-1 ANSI/ANS-8.1-1983, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, Implementation Matrix

ANSI/ANS-8.1-1983[a] section	PSAR or CSER section that Implements Requirement[b]
4.1.2 Process Analysis	
Determine that process will be subcritical under normal and credible abnormal conditions. Determine that a new or modified process will be subcritical under normal and credible abnormal conditions.	Section 6.5.2, Criticality Safety Evaluations, references and summarizes the CSER that documents that the entire WTP waste treatment process will be subcritical under both normal and off-normal operational and credible accident conditions. Section 6.5.1.1 requires that the operations manager ensure that necessary controls required for criticality safety are implemented before fissionable material handling is permitted in a new or modified operation. Section 6.5.1.2 states that a role of the ES&H manager is to ensure that proposed facility designs, design modifications and process changes are reviewed and approved in accordance with the requirements of the CSP. Section 17.4.3, Configuration Management, describes the configuration management program that ensures that changes to physical and functional characteristics of SSCs are properly developed, approved, implemented, verified, and incorporated into facility design documentation.
Care in determining conditions that will result in the maximum k_{eff}.	Section 6.4.5, Evaluation of Normal Operations, and section 6.4.6, Application of Double Contingency Principle, and CSER Chapters 6 and 7 describe the process by which the conditions that might result in the most limiting k_{eff} were identified.
4.1.3 Written Procedures	
NCS affecting processes have procedures.	Section 6.5.3, Criticality Safety Plans and Procedures, states that all operations pertinent to criticality safety, including maintaining controls and limits important to criticality safety, will be governed by written procedures.
Persons shall understand and be familiar with procedures.	Section 6.5.3, Criticality Safety Plans and Procedures, states that all persons participating in these operations (pertinent to criticality safety) will understand and be familiar with the procedures. Section 6.5.1.1 states that the operations manager has the responsibility to ensure that each person selected for handling or supervising the handling of fissionable material has the required qualifications to carry out assigned responsibilities, receives criticality safety and emergency procedure training. Section 12.4.1.3, Training During Facility Operation, states that line managers, in conjunction with operations and technical support training personnel, will have the primary responsibility for conduct of the training programs and will be responsible for providing the resources necessary for their staff to participate in training required for their job function.
Procedures shall specify all parameters they are to control.	Section 6.5.3, Criticality Safety Plans and Procedures, states that new and revised procedures will specify all the procedures they are to control.

Table 6-1 ANSI/ANS-8.1-1983, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, Implementation Matrix

ANSI/ANS-8.1-1983[a] section	PSAR or CSER section that Implements Requirement[b]
No single, inadvertent departure from a procedure should cause a criticality accident.	Section 6.5.3 also states that operating procedures will be written so no single, inadvertent failure to follow a procedure can cause a criticality accident.
4.1.4 Materials Control	
Movement of fissionable material shall be controlled.	Section 6.5.3, Criticality Safety Plans and Procedures, describes the operating procedures that will provide step-by-step instructions for fissionable material handling operations, and that include criticality safety warnings and cautions as appropriate.
Material labeling and postings.	Section 6.5.3 also states that for operations where operating procedures are significant to criticality safety, criticality safety postings will be used to provide the operator with a ready reference to CSLs or controls that are under the operator's control or observation.
4.1.5 Operational Control	
Deviations from procedures and unforeseen alterations shall be reported.	Section 6.5.6, Criticality Infraction Reporting and Follow-Up, states that deviations from operating procedures and unforeseen alterations in process conditions that affect criticality safety are to be immediately reported to management and the CSS without disturbing the material or process in any way.
Actions shall be taken to prevent recurrence.	Section 6.5.6, Criticality Infraction Reporting and Follow-Up, states that action will be taken to ensure that a similar situation does not exist in another portion of the facility and to prevent a recurrence.
4.1.6 Operational Reviews	
At least annually confirm that procedures are being followed and that process conditions have not been altered so as to affect NCS.	Section 6.5.1.2, Environmental, Safety and Health Manager, states that a role of the ES&H manager is to ensure that fissile material operations are subject to at least an annual review by individuals knowledgeable in criticality safety. The review will determine if procedures are being followed and confirm that the criticality safety evaluation represents the current design and operation of the WTP.
These reviews should be conducted by individuals, in consultation with operations, who are knowledgeable in NCS and, to the extent practical are independent of operations.	Section 6.5.1.2 also states that the reviews are to be conducted by reviewers independent of operations, and they will be conducted in consultation with operating personnel.
4.1.7 Emergency Procedures	This section is not applicable because a criticality event in the WTP is not credible. Chapter 15, Emergency Preparedness, addresses emergency planning for the WTP. Section 15.4.5, Protective Actions, describes the protective action guides and emergency plan implementing procedures to be developed for the WTP.

Table 6-1 ANSI/ANS-8.1-1983, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, Implementation Matrix

ANSI/ANS-8.1-1983[a] section	PSAR or CSER section that Implements Requirement[b]
4.2 Technical Practices	No requirements - see subsections below.
4.2.1 Controlling Factors	
All controlled parameters and their limits shall be specified.	Section 6.4.4, WTP Criticality Safety Limits and Defense in Depth, describes the parameters to be controlled for achieving NCS for the WTP.
4.2.2 Double Contingency Principle	Section 6.4.6, Application of Double Contingency Principle, describes the application of the double contingency principle for the WTP.
4.2.3 Geometry Control	Section 6.4.3, Design Features and Justification for the Use of Administrative Controls, states why geometry is not practical for the WTP.
4.2.4 Neutron Absorbers	Neutron Absorbers are not used for NCS control for the WTP; see section 6.4.3, Design Features and Justification for the Use of Administrative Controls.
4.2.5 Subcritical Limits	
Where applicable data are available limits shall be established based on experiments.	Section 6.4.2.1, Methodology, describes the subcritical limits and states that the code used was verified and validated against critical experiments.
In the absence of data applicable to experiments the limits may be derived from calculations.	Not applicable.
4.3 Validation of a Calculational Method	See section 6.4.2.1, Methodology.
4.3.1 (Bias)	
Bias shall be established by correlating the results of critical experiments with the results obtained for these same systems by the method being validated.	Section 6.4.2.1, Methodology, describes how the bias was established based on critical experiments.
Commonly the correlation is expressed in terms of k_{eff} in which case the bias is the deviation of the calculated values of k_{eff} from unity.	The bias provided in section 6.4.2.1, Methodology, is provided in terms of k_{eff}.
4.3.2 (Extension of model)	See section 6.4.2.1, Methodology. No extension to the MCNP code was required.
4.3.3 (Margin in the correlating parameter)	For the WTP the correlating parameter is k_{eff}. See section 6.4.2.1, Methodology.
4.3.4 (Confirmation of computer program)	See section 6.4.2.1, Methodology. No changes to the MCNP computer program were required.

Table 6-1 ANSI/ANS-8.1-1983, Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors, Implementation Matrix

ANSI/ANS-8.1-1983[a] section	PSAR or CSER section that Implements Requirement[b]
4.3.5 (Consistent nuclear properties such as cross sections)	See section 6.4.2.1, Methodology. Cross sections are included in the MCNP and were validated with the code.
4.3.6 (Validation report)	Section 6.4.2.1, Methodology, states that the validation of MCNP 4C for criticality calculations was performed in and documented in accordance with the ANS 8.1 section 4.3. Section 6.5.1.2, Environmental, Safety, and Health Manager, requires that a report should describe the validation of calculational methods with sufficient detail, clarity, and lack of ambiguity to allow for independent duplication of the results.
5 Single-parameter Limits for Fissile Nuclides	This section and accompanying subsections give subcritical limits for various fissile material forms based on controlling a single parameter, such as mass and cylinder diameter. The subcritical limits used in the WTP analysis were calculated with computer codes.
6 Multi-parameter Control	This section and accompanying subsections give subcritical limits for various fissile material forms based on controlling multiple parameters, such as ^{235}U enrichment and mass. The subcritical limits used in the WTP analysis were calculated with computer codes.

a SRD Volume II, Section 3.3 may commit to a later issue of this standard.

b In this table, references to sections in PSAR Chapters 12, 15 and 17 are to 24590-WTP-PSAR-01-001-01, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information.*

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section	PSAR section that Implements Requirement[b]
Introduction	No requirements in this section.
Scope	No requirements in this section.
Definitions	No requirements in this section.
Management Responsibilities	No requirements- see subsections.
4.1 Management responsible for safety and continuing safety evident.	Section, 17.3.2, Organizational Responsibilities, states that line management is responsible for developing and implementing the safety basis and that line management's responsibility for safety may not be delegated. Section 6.5.1, Criticality Safety Organization, describes the roles within the WTP for criticality safety. Section 17.4.2, Safety Review and Performance Assessments, describes safety reviews and performance assessments that verify that public and worker safety considerations, and protection of the environment are reflected in the design, procurement, construction, and commissioning of the facility.
4.2 Formulate and make CSP known	Section 6.5.1.3, Radiological Safety Manager, states that the Radiological Safety Manager implements and maintains the criticality safety program during design, construction, and commissioning of the facility and informs employees involved in operations with fissile material of the program. The distinction between shielded and unshielded facilities is not of importance to the WTP.
4.3 Assignment of responsibility and individuals aware of CSP	Section, 17.3.2, Organizational Responsibilities, states that line management is responsible for developing and implementing the safety basis and that line management's responsibility for safety may not be delegated. Section 6.5.1, Criticality Safety Organization, shows that the assignment for NCS responsibility is consistent with other safety disciplines. Section 6.5.1.3, Radiological Safety Manager, states that the Radiological Safety Manager informs WTP employees involved in operations with fissile material of the CSP.
4.4 Qualification of CSP personnel	Section 6.5.1.3, Radiological Safety Manager, states that a role of the radiological safety manager relative to criticality safety is to appoint a CSS independent of operations who is familiar with the physics of nuclear criticality and associated safety practices to coordinate the development and implementation of CSLs and controls.

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section		PSAR section that Implements Requirement[b]
4.5	Monitoring of CSP	Section 6.5.1.2, Environmental, Safety and Health Manager, states that a role of the ES&H manager is to ensure that fissile material operations are subject to at least an annual review by individuals knowledgeable in criticality safety. The review will determine if procedures are being followed and confirm that the criticality safety evaluation represents the current design and operation of the WTP. The performance of audits and assessments in a general manner is described in Section 17.4.2, Safety Review and Performance of Assessments, and in 24590-WTP-QAM-QA-01-001, *Quality Assurance Manual* (policies Q-10.1, Inspection, Q-18.1, Quality Assurance Assessment (Audit), and Q-18.3, Management Assessment).
4.6	Periodic management audits of CSP	Section 6.5.1.2, Environmental, Safety and Health Manager, states that a role of the ES&H manager is to ensure that fissile material operations are subject to at least an annual review by individuals knowledgeable in criticality safety. The review will determine if procedures are being followed and confirm that the criticality safety evaluation represents the current design and operation of the WTP.
4.7	Use of consultants acceptable	Section contains a permission statement only. Section 6.5.1.4, Criticality Safety Specialist, states that the CSS should request assistance when needed on criticality safety matters.
Supervisory Responsibilities		No requirements - see subsections.
5.1	Supervisors accept responsibility for safety	Section, 17.3.2, Organizational Responsibilities, states that line management is responsible for developing and implementing the safety basis and that line management's responsibility for safety may not be delegated.
5.2	Supervisors knowledgeable of NCS. CSP group provides training and assistance.	The WTP managers are responsible for integrating Integrated Safety Management Systems into work processes (section 17.3.2.1, Design, Construction, and Commissioning Contractor Roles and Responsibilities). It is not necessary to make specific reference to NCS. Section 12.4.1.3, Training During Facility Operation, states that line managers, in conjunction with operations and technical support training personnel, will have the primary responsibility for conduct of training programs and will be responsible for providing the resources necessary for their staff to participate in training required for their job function. Section 6.5.1.1 states that the operations manager has the responsibility to ensure that each person selected for handling or supervising the handling of fissionable material has the required qualifications to carry out assigned responsibilities, receives criticality safety and emergency procedure training.
5.3	Training, procedure understanding, and training records.	See response for section 5.2. Training records are subject to the project document control system (section 17.4.4, Document Control and Records Management).

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section		PSAR section that Implements Requirement[b]
5.4	Supervisors support procedure development and maintenance.	The WTP Project procedures organization will develop, maintain, and control procedures (section 12.3.1.1, Design and Construction Phase Procedures Program and section 12.3.1.2, Operational Phase Procedures Program). Procedure reviews by affected organization are required to ensure that appropriate administrative and engineering controls are incorporated (section 12.3.2.1, Design and Construction Phases Procedure Development). These reviews also ensure that proposed processes effectively mitigate identified hazards and satisfy quality assurance requirements. The CSS reviews procedures that implement criticality safety (section 6.5.1.4, Criticality Safety Specialist). Section 12.3.3.2.1, Procedure Changes, addresses the need to maintain procedures current with the design, safety analysis, operation, and vendor information.
5.5	CSP change management for new or modified equipment.	Section 17.4.3, Configuration Management, describes the configuration management program that ensures that changes to physical and functional characteristics of SSCs are properly developed, approved, implemented, verified, and incorporated into facility design documentation. Section 6.5.1.2 states that a role of the ES&H manager is to ensure that proposed facility designs, design modifications and process changes are reviewed and approved in accordance with the requirements of the CSP.
5.6	Conformance to safety practices including identification of fissile material and good housekeeping.	Line management is responsible for developing and implementing the safety basis (section 17.3.2, Organizational Responsibilities). It is not necessary for the WTP to emphasize preventing the ambiguous identification of fissile materials. Fissile materials for the WTP are not identified, as they need to be in a fuel fabrication plant where fissile material of different enrichment must be clearly and carefully identified. Section 10.5.9, Facility Condition Inspections addresses housekeeping.
Nuclear Criticality Safety Staff Responsibilities		No requirements - see subsections.
6.1	NCS staff provide guidance on the design, processes, and operation.	Section 6.5.1.4, Criticality Safety Specialist, states that a role of the CSS, is to provide technical guidance for the design of equipment and processes that involve fissionable material and provide independent NCS review, analysis and approval of the design or modification of fissionable material processes, systems, and equipment.
6.2	NCS staff remain knowledgeable of new developments in NCS.	Section 6.5.1.4, Criticality Safety Specialist, states that a role of the CSS is to maintain technical skills in criticality physics, track developments in analytical methods, computer codes and applicable criteria.
6.3	NCS obtain consultation when necessary	Section 6.5.1.4, Criticality Safety Specialist, states that a role of the CSS should request assistance when needed on criticality safety matters.
6.4	NCS understand operations	Section 6.5.1.4, Criticality Safety Specialist, states that a role of the CSS is to maintain familiarity with the WTP facility and the controls and limits established for the prevention of a nuclear criticality.
6.5	NCS staff assist in training	Section 6.5.1.4, Criticality Safety Specialist, states that the CSS is to assist with training to ensure that personnel are provided with criticality training appropriate for their assigned responsibilities.

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section		PSAR section that Implements Requirement[b]
6.6	NCS conduct or support audits	Section 6.5.1.4, Criticality Safety Specialist, states that the CSS is to conduct or participate in audits of criticality safety practices and procedure compliance.
6.7	NCS review occurrence reporting	Section 6.5.1.4, Criticality Safety Specialist, states that the CSS is to examine reports of procedural violations, control/limit violations, and other deficiencies related to criticality safety for possible improvement of practices and procedures, and to implement the corrective actions.
Operating Procedures		No requirements - see subsections.
7.1	Procedure convenient and concise	Section 6.5.3, Criticality Safety Plans and Procedures, states that operating procedures will be organized and presented for convenient use by operators and that procedures will be free of any extraneous material.
7.2	Procedures to control NCS and with single failure lead to criticality accident.	Section 6.5.3, Criticality Safety Plans and Procedures states that all operations pertinent to criticality safety, including maintaining controls and limits important to criticality safety, will be governed by written procedures. Section 6.5.3 also states that operating procedures will be written so no single, inadvertent failure to follow a procedure can cause a criticality accident.
7.3	Revise procedures as improvements become desirable.	Section 12.3.3.2.1, Procedure Changes, states that the procedure change process will be used to proceduralize modifications to important to safety (ITS) structures, systems and components (SSCs), processes, or requirements; and to correct procedural errors, ambiguities, and human factor deficiencies that could result in personnel error or unsafe job performance. This section further states that procedure modifications can result from issues identified during training activities and from efforts to resolve occurrences resulting from personnel errors or equipment malfunctions.
7.4	Periodic review of procedures	Section 12.3.3.2.2, Periodic Review of Procedures, states that administrative procedures will be reviewed at periodic intervals to ensure that information and instructions are technically accurate and appropriate human-factor considerations have been included. This process will specify that operations and maintenance procedures affecting ITS SSCs will be reviewed at least every two years. Procedures that implement the requirements identified in TSR administrative controls will be reviewed at least every three years.
7.5	Review of procedures that have an impact on NCS.	Section 6.5.3, Criticality Safety Plans and Procedures, states that new or revised procedures that impact criticality safety will be reviewed and approved by the CSS before they are used.
7.6	Procedures supplemented by postings.	Section 6.5.3, Criticality Safety Plans and Procedures, states that where operating procedures are significant to criticality safety, criticality safety postings will be used to provide the operator with a ready reference to CSLs or controls that are under operator control or observation.

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section	PSAR section that Implements Requirement[b]
7.7 Deviations from procedures impacting NCS.	Section 6.5.6, Criticality Infraction Reporting and Follow-Up, states that deviations from operating procedures and unforeseen alterations in process conditions that affect criticality safety are to be immediately reported to management and the CSS without disturbing the material or process in any way.
7.8 Annual review of operations	Section 6.5.1.2, Environmental, Safety and Health Manager, states that a role of the ES&H manager is to ensure that fissile material operations are subject to at least an annual review by individuals knowledgeable in criticality safety. The review is to determine if procedures are being followed and confirm that the criticality safety evaluation represents the current design and operation of the WTP.
Process Evaluation for Nuclear Criticality Safety	No requirements - see subsections.
8.1 Determine entire process will be subcritical	Section 6.5.2, Criticality Safety Evaluations, references and summarizes the CSER that documents that the entire WTP waste treatment process will be subcritical under both normal and off-normal operational and credible accident conditions.
8.2 Determine and identify NCS control parameters.	Section 6.5.2, Criticality Safety Evaluations, requires that the CSER will explicitly identify the controlled parameters and associated limits on which criticality safety depends. The effect of changes in these parameters, or in the conditions to which they apply, will be understood.
8.3 Level of detail	Section 6.5.2, Criticality Safety Evaluations, requires that the CSER document the evaluation with sufficient detail, clarity, and lack of ambiguity to allow independent judgment of the results.
8.4 Independent assessment of CSER before operation.	Section 6.5.2, Criticality Safety Evaluations states that the CSER has been independently reviewed by a second CSS to confirm the technical adequacy of the evaluation and is approved by the Project Safety Committee. Also see section 6.5.5, Criticality Safety Inspections/and Audits.
Materials Control	No requirements - see subsections.
9.1 Control of movement of fissile material	Section 6.5.3, Criticality Safety Plans and Procedures, describes the operating procedures that will provide step-by-step instructions for fissionable material handling operations, and that include criticality safety warnings and cautions as appropriate.
9.2 Material handling and area postings	Section 6.5.3, Criticality Safety Plans and Procedures, states that for operations where operating procedures are significant to criticality safety, criticality safety postings will be used to provide the operator with a ready reference to CSLs or controls that are under the operator's control or observation.
9.3 Maintaining presence of neutron absorbers when credited.	Section 6.5.2, Criticality Safety Evaluations, states that all operations pertinent to criticality safety, including maintaining controls and limits important to criticality safety will be governed by written procedures. Currently no credit is taken from engineered neutron absorbers.

Table 6-2 ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety, Implementation Matrix

ANSI/ANS-8.19-1996[a] Section		PSAR section that Implements Requirement[b]
9.4	Control of access to fissile material areas.	Because fissile material for the WTP is contained within the waste streams at very low concentrations, control specific to the storage, handling, and processing of fissile materials is not required.
9.5	Control of spacing, mass, density, and geometry.	Section 6.4.4, WTP Criticality Safety Limits and Defense in Depth, identifies limits imposed on the waste received in the WTP for criticality safety.
Planned Response to Nuclear Criticality Accidents		The need for a planned response to a criticality event is not necessary for the WTP as criticality is not credible in the facility.

a SRD Volume II, Section 3.3 may commit to a later issue of this standard.

b In this table the references to sections within PSAR Chapters 12 and 17 are to 24590-WTP-PSAR-01-001-01, *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information*. The reference to PSAR Section 10.4.9 is to 24590-WTP-PSAR-01-002-01, *Preliminary Safety Analysis Report to Support Construction Authorization; General Information*.

Table 6-3 Envelope D Characterization Data Significant to Criticality Safety

Nuclide	Inventories for Tanks (kg)						
	AZ-101	AZ-102	AY-102	AY-101 C-104	SY-102	C-107 AW-103	AW-104 AW-103
Al	9071.2	3795.0	27992.0	81707.4	17544.3	28874.4	47231.6
Bi	0.0	0.0	0.6	21.8	382.3	14471.2	163.0
CO_3^{-2}	1.3	6881.0	73931.8	8686.8	3499.3	10231.4	54.9
Fe	20191.5	37507.3	61019.8	39583.9	4493.6	41145.0	4995.5
Mn	613.6	821.4	7404.5	6716.5	1267.8	2018.7	1631.7
Na	3803.7	9879.5	55868.7	90584.2	58484.4	53527.9	1836.6
Ni	1183.5	2541.7	727.7	2648.0	187.2	1340.0	2027.5
NO_2	2791.2	95.0	71.2	137.5	510.5	103.0	109.2
NO_3	2167.6	55.6	14.9	175.1	938.2	29904.2	588.8
OH (bound)	41198.8	74485.6	112937.7	273356.9	40410.8	125440.6	26838.7
PO_4^{-3}	91.6	0.0	2876.9	2513.3	2957.0	24930.0	1254.1
TOC	1306.2	653.1	8147.1	7729.1	5576.5	2513.8	4844.6
Zr	7154.2	5199.6	807.7	75137.5	272.8	65410.0	46293.0
Fissionable Nuclide	**Fissionable Nuclide Inventories (kg)**						
^{238}Pu	0.007	0.007	0.004	0.011	0.000	0.003	0.005
^{239}Pu	12.772	15.571	22.054	69.117	28.903	18.479	14.663
^{240}Pu	0.984	1.261	1.259	3.901	1.961	1.000	1.211
^{241}Pu	0.038	0.066	0.023	0.060	0.001	0.014	0.035
^{233}U	0.01	0.02	0.00	42.71	0.04	0.00	0.06
^{235}U	13.9	27.9	23.6	283	4.8	104.6	62.9
^{238}U	1620	3270	3030	35400	700	12100	400
Total	**97645**	**163810**	**378879**	**614934**	**167554**	**444897**	**160286**
Fraction of Actual	*91.8 %*	*86.6 %*	*92.9 %*	*95.8 %*	*81.5 %*	*89.9 %*	*86.0 %*
	Absorber Ratios						
$^{238}U/^{235}U$	117	117	129	125	146	116	118
Fe/F	1463	2219	2614	542	146	2110	314
Mn/F	44	49	317	92	41	104	103
Ni/F	86	150	31	36	6	69	127
	F Mass Loading ($gF/100g_{NVS}$)						
Loading	0.015	0.012	0.007	0.012	0.023	0.005	0.012
Concentration Factor	*118%*	*110 %*	*131 %*	*142 %*	*203 %*	*136 %*	*118 %*

Table 6-4 Low-Activity Waste Liquid Activities and Concentrations

Envelope	Allowed TRU Activity Bq/M Na	Concentrations	
		Na moles/L	Pu gF/L
A & B	4.8×10^5	4 to 10	0.00218
C	3.0×10^6		**0.013**

Table 6-5 High-Level Waste Solids Activities and Loadings

	Contract Limits		**MCNP Models**	
Nuclides	**Activity Ci/100g_{wo}**	**Loadings g/100g_{wo}**	**Old CWM g/100g_{wo}**	**New CtM g/100g_{wo}**
Phosphorus		1.7	6.9	1.7
Silicon		19	3.8	19
Sodium		19	21.5	18.7
Aluminum	No Activity	14	7.2	0
Iron		29	19.9	19.9
Oxygen		no limit	40.7	40.7
Total			100.0	**100.0**
Plutonium		**0.054**		
^{238}Pu	3.5×10^{-4}	0.00002	Only ^{239}Pu is modeled; see section 6.4.2.2.1	
^{239}Pu	3.1×10^{-3}	0.05	0.210	**0.205**
^{241}Pu	2.2×10^{-2}	0.0002		
Uranium		14	Only ^{239}Pu is modeled; see section 6.4.2.2.1	
^{233}U	2.0×10^{-4}	0.021		
^{235}U	2.5×10^{-7}	0.119		
^{237}Np	7.4×10^{-5}	1.14		

Table 6-6 Summary of Contingent Conditions

	Contingency
Feed Receipt	
Contingency 7.1.1	WTP Feed has High Fissionable Concentrations or Loadings
Contingency 7.1.2	Waste Stream Mixing
Contingency 7.1.3	Fissile Solids Settle in a Vessel
Contingency 7.1.4	Vessel Backwashed with > 2 M Nitric Acid
Feed Evaporators	
Contingency 7.2.1	Waste Over-concentration
Sr/TRU Precipitation	
Contingency 7.3.1	Incorrect Amounts of Reagents for Sr/TRU Precipitation
Contingency 7.3.2	Selective Precipitation of Pu
Contingency 7.3.3	Sr/TRU Precipitation Feed is Not Heated
Ultrafilters	
Contingency 7.4.1	Failed of Ultrafilter Tubes
Contingency 7.4.2	Plugged Ultrafilters
Contingency 7.4.3	Selective Dissolution of Pu
Contingency 7.4.4	Selective Dissolution of Absorbers
Cesium and Technetium Ion Exchange	
Contingency 7.5.1	Solids Enter IX
Contingency 7.5.2	Fissile Loading on the IX Columns
LAW Evaporator and LAW Storage and Feed Prep	
Contingency 7.6.1	Dry Out of the Evaporator
Contingency 7.6.2	^{233}U Deposits in the LAW Evaporator
Contingency 7.6.3	Pu Deposits Form in LAW Evaporator
Contingency 7.6.4	Solids Enter LAW Evaporator
Melters and Glass Product	
Contingency 7.7.1	Failure to Add Glass Former
Contingency 7.7.2	Solids Settle or Plate-out in HLW Melter
Contingency 7.7.3	Unexpected Glass Composition

Table 6-6 Summary of Contingent Conditions

	Contingency
Other Contingencies	
Contingency 7.8.1	Vessels Boil
Contingency 7.8.2	Fire-fighting or Flooding
Contingency 7.8.3	Electrical Power Loss

9 Waste Management

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9 Waste Management

9.1 Introduction

The purpose of this section is to provide reasonable assurance that the proposed radioactive and hazardous waste management measures for the River Protection Project - Waste Treatment Plant (WTP) adequately protect public health and the environment. The overall radioactive and hazardous waste management program and organization will be finalized before hot commissioning. The WTP will implement a radioactive and hazardous waste management program to provide for safe control, collection, and handling of wastes generated during operations at the WTP facilities. This chapter discusses the requirements, objectives, plans, and procedures that will be relied upon to ensure safe normal operations, and identifies radioactive and hazardous waste streams and sources. The WTP waste management processes will adequately protect the health and safety of the worker, the public, and the environment in a manner that meets as low as reasonably achievable (ALARA) criteria for radioactive and hazardous waste.

9.2 Requirements

The requirements that form the basis for the radioactive and hazardous waste management are found in sections 5.3 and 5.4 of the *Safety Requirements Document* (SRD) (24590-WTP-SRD-ESH-01-001), Volume II. The SRD contains details including the implementing codes and standards and the regulatory basis. These codes and standards include:

Safety Requirements Document

Section 5.3, Environmental Radiation Protection; Safety Criteria 5.3-1 through 5.3-8

Section 5.4, Environmental Radiation Monitoring; Safety Criteria 5.4-1 through 5.4-10

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 9
1.5	Environmental Radiation Protection Program	9.7, "Environmental Radiological Protection Plan."

Resource Conservation and Recovery Act of 1976 (RCRA 1976)

Clean Air Act of 1970 (CAA 1970)

Clean Water Act of 1977 (CWA 1977)

Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA 1986)

Atomic Energy Act of 1954

Hazardous Waste Management Act of 1976 (RCW 1976), State of Washington

The Washington State Department of Ecology (Ecology) administers RCRA in line with federal standards and guidelines. To comply with RCRA, a *Dangerous Waste Permit Application* (DWPA) (24590-WTP-DWPA-ENV-01-001) has been prepared for the treatment facility, which will be incorporated as a chapter of the *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste* (Ecology 1994) upon approval by the state.

The State of Washington is the regulating body for the Clean Air Act, including the *Hanford Site Air Operating Permit* (Ecology 2001). The US Environmental Protection Agency (EPA) administers the *National Emission Standards for Hazardous Air Pollutants* (NESHAP) (40 CFR 61) and New Source Performance Standards programs. The WTP air permits will be incorporated into the *Hanford Site Air Operating Permit.* The state also has primacy for the Clean Water Act of 1977, which includes all wastewater generated from operation of the treatment plant.

The US Department of Energy (DOE) is the regulatory authority for radioactive material requirements under the Atomic Energy Act of 1954. The DOE Office of Safety Regulation acts as the regulator for all nuclear and radiological processes for the project, and is responsible for overseeing the nuclear and process safety of the WTP. The Office of Safety Regulation will review and approve the prepared Authorization Basis as required for designing, constructing and commissioning the WTP. Although the Office of Safety Regulation's responsibility does not include environmental regulations, it consults with the Washington State regulators on aspects of the project that would affect both regulatory bodies.

The *River Protection Project – Waste Treatment Project Environmental Plan* (WTP Environmental Plan) (PL-W375-EN00012) provides details of the WTP team's compliance with environmental regulations, including planned environmental permitting and compliance activities, environmental monitoring, record keeping, and reporting, and for environmental activities linked to the WTP Fiscal Year 2001 Re-Baseline Schedule. The WTP Environmental Plan has been prepared to address strategies and the timing of activities to comply with the applicable laws. The Environmental Plan considers the requirements for both hazardous and radiological waste.

In the record of decision for the *Final Environmental Impact Statement for the Tank Waste Remediation System* (DOE 1996), DOE committed to an environmental monitoring program to evaluate releases to the environment associated with the operation of the WTP. The operation of the WTP will be monitored by WTP personnel and overseen by DOE.

9.3 Radioactive and Hazardous Waste Management Program and Organization

The following paragraphs summarize the planned hazardous waste management program and the proposed organization and functions of that program.

9.3.1 Program Summary

The environmental monitoring program will supplement the existing environmental monitoring program on the Hanford Site. Existing analytical data and baseline information regarding site contamination will be used to the fullest extent possible. The environmental monitoring will be specific to the WTP location. Monitoring during program implementation serves a number of purposes, including:

- Ensure compliance with laws and regulations that require environmental monitoring (such as the Clean Air Act, RCRA, and the *Hazardous Waste Management Act of 1976*), Hanford Site requirements (such as monitoring liquid effluents for compliance with Effluent Treatment Facility [ETF], and Treated Effluent Disposal Facility acceptance criteria)

- Determine the impact of WTP commissioning on key elements of the environment, such as air, soil, and cultural resources
- Determine the effectiveness of mitigating measures incorporated into the facility during construction and air emissions controls during commissioning
- Implement a program to track and address environmental compliance issues

In addition to the permits required by WTP, several Hanford facilities will be required to obtain permit modifications to accept the WTP's immobilized high-level waste, immobilized low-activity waste, vitrified glass product, and secondary wastes. The WTP will provide information required by other Hanford contractors to obtain permit modifications. The successful implementation of the Environmental Plan requires a coordinated effort by DOE, Hanford Site contractors, Ecology, the Washington State Department of Health, the EPA, and the WTP. The WTP project will comply with all applicable reporting requirements.

A number of project management processes and procedures are in place to ensure the accuracy of project permits, licenses, and documents. Project procedures control the development of permitting documents and require interaction among Project disciplines and between the WTP and regulatory agencies. Project procedures also require a multi-disciplinary review of environmental permits and documents. Comments developed during this review process must be resolved before approval of the applicable document. Additionally, a committee of WTP engineering, operations, and environmental safety, and health management reviews and discusses the documents. Comments from the committee are resolved before the document's approval.

The WTP waste management philosophy revolves around protecting workers, the public, and the environment, ensuring proper management of waste from its point of generation to its final disposition, and ensuring compliance with applicable federal, state, and local laws and regulations. To meet these goals, the WTP policy is to conduct operations and activities in a way that minimizes the quantity and toxicity of wastes generated, eliminates or minimizes pollutant releases to the environment, and minimizes the use of toxic substances.

WTP policy also requires ALARA radioactive and hazardous material exposure of workers, visitors, the public, and the environment. Waste management procedures governing solid waste treatment, segregation, monitoring, characterization, packaging, storage, transportation, and disposal will be prepared, reviewed, approved, issued, and maintained according to WTP administrative procedures. Procedures will be in place for anticipated operations, maintenance, tests, and abnormal or emergency situations. The *Preliminary Safety Analysis Report to Support Partial Construction Authorization; General Information* (PSAR General Information) volume, Chapter 12, describes the WTP procedure program for the facilities.

9.3.2 Waste Minimization Plan

Waste minimization is the prevention or reduction of waste at the source (for example, use of alternative, less hazardous materials) or reduction of the quantity of pollutants, contaminants, hazardous substances, or waste for treatment, storage, or disposal. Waste minimization also includes any source reduction or recycling activity that results in reduction of the total volume of waste, reduction of the toxicity of waste, or both, as long as that reduction is consistent with the general goal of minimizing present and future threats to human health and the environment. The hierarchy of waste management practices places highest priority on source reduction, recycling, and treatment, storage, and disposal (TSD).

Federal and state regulations require hazardous waste generators and TSD facilities to have a waste minimization program. The WTP will formalize a waste minimization program that specifies activities and methods that will reduce the quantity and toxicity of the waste generated. A waste minimization program plan targets all waste types: radioactive, hazardous, mixed, and non-regulated.

A pollution prevention plan is now being prepared that will describe the Project's path for implementing and integrating pollution prevention and waste minimization procedures. The plan will be implemented by facility administrative procedures and will contain the key elements of source reduction, toxicity reduction, volume reduction, and product substitution.

9.3.3 Radioactive and Hazardous Waste Management Organization

The operations organization outlined in the PSAR General Information volume, Chapter 17, administers the radioactive and hazardous waste management program in the WTP facilities. Facility personnel, as waste generators, have the responsibility to ensure all newly generated wastes are handled, stored, and packaged in accordance with requirements. WTP personnel will implement the radioactive and hazardous waste management processes. The waste management organizational structure will be described in more detail as the project matures.

9.4 Radioactive and Hazardous Waste Management Processes

The following sections identify WTP radioactive and hazardous waste management and handling processes, and facility-specific waste streams and sources.

9.4.1 Waste Management Process

The waste management process involves programs to address solid waste, air quality, and water quality associated with potential WTP discharges to the environment. The goals and policies for each of these processes are described in the following sections.

9.4.1.1 Solid Waste Management Process

The solid waste management process goals are as follows:

- Collect, store, and dispose of waste in a safe, economical, and environmentally acceptable manner
- Segregate, package, and ship nonradioactive wastes to the appropriate disposal or recycling facility
- Segregate radioactive waste to prevent cross-contamination of radionuclides

A DWPA that addresses the storage and treatment of the Hanford tank waste was submitted to Ecology for approval. The permit addresses storage units in the facility and the processes for treating the mixed waste to meet waste form, land disposal, and volume reduction requirements. The WTP treatment units will be regulated as follows:

- The High-Level Waste (HLW) and Low-Activity Waste (LAW) melters will be regulated as miscellaneous thermal treatment units under the *Washington Administrative Code* (WAC) 173-303-680
- The container storage areas will be regulated under WAC 173-303-630

- The containment buildings will be regulated under WAC 173-303-695
- Tank systems will be regulated under WAC 173-303-640

The WTP will follow the waste acceptance criteria of receiving facilities for secondary waste disposal.

The WTP will be incorporated as a unit within the Hanford Site dangerous waste permit and will comply with specific general conditions of this permit. Additional conditions will be identified in the dangerous waste permit when it is issued.

9.4.1.2 Air Quality Waste Management Process

The required air permit applications are

- A prevention of significant deterioration (PSD) permit application (WAC 173-400-141 and 40 CFR 52.21)
- A toxic air pollutants application (WAC 173-400 and WAC 173-460)

A radioactive air emissions license application (WAC 246-247) also serves as a NESHAP permit application (40 CFR 61). The air permits and applications address the control of air emissions from the WTP. Approved air permits and applications are required to support start of construction.

The PSD permit will address the criteria pollutants such as carbon monoxide, sulfur dioxide, nitrogen oxides, and particulates. The radioactive air emissions license and the NESHAP permit will address the radioactive air emissions. The toxic air pollutants permit will address the emissions of toxic pollutants.

Ecology will issue the PSD and toxic air pollutant permits; and the Washington State Department of Health and the EPA Region 10, respectively, will issue the radioactive air emissions license and NESHAP permit.

The *Hanford Site Air Operating Permit* and license will add WTP as the WTP operator and incorporate the WTP and PSD approvals. WTP will comply with all applicable reporting requirements regarding the air operating permit and license.

9.4.1.3 Water Quality Waste Management Process

The following normal precautions are necessary and will be followed to protect the environment.

- Obtain permits and permit modifications for the WTP facilities, as applicable.
- Ensure that septic systems are permitted in accordance with WAC 246-272. Sewage permits are issued by the Washington State Department of Health. The WTP is designing and intends to apply for a permit for four septic systems to support the project.
- Maintain facility operations within permit and regulatory requirements.
- Ensure compliance with the requirements of the regulatory codes and applicable permits.
- Provide prompt notifications of failures in the sampling process or of any releases that exceed the requirements defined in applicable waste water permits.

- Ensure (where required for liquid discharges) that a facility effluent monitoring plan is issued and that annual reviews are provided.
- Ensure that training is provided for personnel who collect samples and verify and maintain personnel qualification records.
- Ensure proper use of sewage systems through strict adherence to operating procedures.
- Comply with spill prevention and reporting requirements, as applicable.

The potential exists to generate regulated soil column discharges. These discharges are expected to be covered under the following three existing Hanford Site permits:

- Permit ST 4508 - *Hydrotest, Maintenance, and Construction Discharges* (Ecology 1997)
- Permit ST 4509 - *Cooling Water and Condensate Discharges* (Ecology 1998)
- Permit ST 4510 - *Industrial Stormwater Discharges to Engineered Structures* (Ecology 1999)

Discharges requiring permit coverage must comply with the conditions identified in the applicable permit. One permit condition that applies to each of the above permits is to develop and comply with a pollution prevention and best management practices plan. A site-wide plan was developed and approved by Ecology for use with the permits (*Pollution Prevention and Best Management Practices Plan*, DOE-RL 2000). It contains applicable permit requirements and pollution prevention activities to be followed before, during, and after discharges.

A draft water quality program procedure has been developed for use on the entire WTP facility. The procedure will ensure that the project complies with permit conditions, and with DOE-RL 2000.

In accordance with WAC-173-216, *State Waste Discharge Permit Program*, WTP will discharge liquid effluents to the 200 Area Treated Effluent Disposal Facility and to the ETF. Both of these facilities have current WAC-173-216 permits (ST 4502 and ST 4500 respectively). Before WTP effluents are transferred to those facilities, WTP will work with DOE and the Hanford Site contractor to modify the permits to add the newly identified waste streams.

9.5 Waste Sources and Characteristics

In addition to the vitrified glass product, the pretreatment processes and the LAW and HLW vitrification processes will generate a variety of solid, liquid, and gaseous waste streams. Some of these waste streams include waste derived from the incoming feed from the double-shell tank (DST) system unit. Other wastes include spent materials used in processing the waste feed, such as rinsate and scrubber solutions that come into contact with the waste feed or its derivatives, and contaminated equipment. General facility operations and maintenance activities will also generate dangerous waste.

The following subsections summarize how and where WTP waste is generated and how it enters the appropriate waste handling or treatment system. Specific waste sources and characteristics are addressed for each of the waste forms.

9.5.1 Air Emissions

Emissions from stacks that vent the WTP processes will be monitored in accordance with the Hanford Site air permit, as required by WAC 173-303-395(2). Monitoring and sampling to address those air emissions concerns are handled under permit. Under the dangerous waste regulations, the WTP must evaluate air emissions to determine the applicability of the air emissions requirements in WAC 173-303, Subparts AA, BB, and CC.

9.5.1.1 Air Emission Standards for Process Vents (Subpart AA)

WAC 173-303-690, Subpart AA, regulates process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that manage hazardous wastes with organic concentrations of at least 10 parts per million by weight. WAC 173-303-690 incorporates by reference the provisions of 40 CFR 264.1031 through 40 CFR 264.1036. Since the WTP does not use any of these listed devices or processes, it will not be subject to regulation under Subpart AA.

9.5.1.2 Air Emission Standards for Equipment Leaks (Subpart BB)

WAC 173-303-691, Subpart BB, applies to equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 % by weight. This provision will not apply to the facility because the WTP will not accept wastes with organic concentrations at or above 10 % by weight. Compliance with this provision will be documented through analyses of verification samples.

9.5.1.3 Air Emission Standards for Tanks, Impoundments, and Containers (Subpart CC)

The requirements for control of emissions from tanks, impoundments, and containers, Subpart CC, are found in WAC 173-303-692 and 40 CFR Parts 264.1081 through 264.1091, incorporated by reference. Waste management units, including tank systems used for managing mixed waste at the WTP will be exempt from the requirements of Subpart CC as provided by WAC 173-303-692(1)(b)(vi). However, during cold commissioning, the WTP will be required to comply with Subpart CC for tanks, since cold commissioning material will be spiked with simulant volatile organic compounds greater than 500 parts per million. During cold commissioning, tank standards at 40 CFR 264.1084 will be met by using tanks with a fixed roof that will be vented through closed-vent systems to control devices. The closed-vent systems and control devices will meet the requirements of 40 CFR 264.1087, as applicable to the particular control device. Control devices are listed and details of the closed-vent systems and control devices are provided in the DWPA.

Subpart CC may apply to newly generated wastes, accumulated or stored in containers, not designated as dangerous waste only (wastes that are not mixed waste). These wastes will be managed in accordance with Subpart CC, as appropriate.

9.5.2 Secondary Waste Streams

Secondary waste streams are divided into solid waste streams (see section 9.5.2.1) and liquid waste streams (see section 9.5.2.2). Dangerous waste streams generated at the WTP will meet the waste acceptance criteria or protocols established by the receiving TSD facilities' permits and operating authority. This document does not outline the details of sampling and analyzing each waste stream because each TSD receiving waste may update its waste acceptance criteria and thus, alter the required waste analyses. Specific information for each of the facilities will be discussed in the facility-specific volumes as necessary.

This section discusses the management of secondary waste streams regulated as dangerous waste. Secondary waste streams that will be transferred back to the DST system unit will be designated with waste numbers consistent with those initially provided by the DST system unit, because secondary wastes are derived from the waste feed without the addition of dangerous waste constituents. Waste transferred to the DST system unit will meet the DST waste acceptance criteria.

The following general information related to waste classification applies to all solid and liquid secondary waste streams:

- Analytical method procedures for determining waste numbers will be performed according to the latest revision of the applicable SW-846 (EPA 1997a) method.
- Acceptable knowledge for waste designation of secondary waste will include analytical data or process knowledge.
- Some waste streams will be designated using acceptable process knowledge, which includes:
  - Historical analytical data
  - Mass balance from a controlled process with a specified output for a specified input
  - Material safety data sheets (MSDS)
  - Analytical data on the waste from a similar process
  - For mixed waste, process knowledge could include information from surrogate material
- Reactive and ignitable waste numbers will be removed from the DST material and will not apply to secondary waste derived from waste feed.
- The listed waste numbers F001 through F005 will follow the secondary waste if the secondary waste is derived from the waste feed.
- Secondary wastes not derived from the waste feed will be characterized and designated with the appropriate EPA hazardous waste numbers and Washington State dangerous waste numbers and managed accordingly.
- Documentation of the process knowledge or analytical data used to designate the waste numbers will be maintained in the WTP operating record. Waste transferred to the DST system unit will meet the DST waste acceptance criteria.

Characteristic waste numbers can be removed after testing or the application of process knowledge, as appropriate.

9.5.2.1 Solid Waste Streams

Solid waste streams will be transferred to Hanford TSDs in accordance with the current *Hanford Site Solid Waste Acceptance Criteria* (HNF 1998). The WTP will meet the unit-specific waste acceptance criteria for receiving Hanford TSD. Solid wastes stored at WTP will meet the acceptance criteria of the specific WTP storage area.

9.5.2.1.1 Solid Waste Designated as Mixed Waste

Solid waste streams that will come into contact with the waste feed radioactive materials during any stage of treatment will be designated as mixed waste by process knowledge. These secondary waste streams are listed in Table 9-1. EPA hazardous waste numbers and Washington State dangerous waste numbers will be assigned to these mixed waste streams, based on the characterization of the waste feed. Each waste stream will meet the waste acceptance criteria of the receiving facility. Each of these mixed waste streams is discussed below.

Out-of-Service Melters

It is anticipated that melters will require replacement at some point, due to the harsh conditions of the vitrification process. When the end of a melter's operational life is reached, as much residual molten glass will be removed as practical, as immobilized product. The melter will be allowed to cool and will be disconnected from all systems.

The locally-shielded melter (LSM) will be a disposal container or overpack, defined as a RCRA miscellaneous unit, containing the LAW melter. The LSM, including residual glass, will be the final disposal container. After disconnection, the openings will be welded closed to provide complete containment. The LAW LSM will be transported to a permitted Hanford TSD. A more complete description of the LSM is provided in the DWPA.

A HLW melter that is removed from service and meets the hanford site solid waste acceptance criteria will be placed into an overpack that will serve as its disposal container. The over-packed HLW melter will be transported to a permitted Hanford TSD.

An out-of-service HLW melter may not meet the Hanford Site solid waste acceptance criteria, depending on its radionuclide content. If this should occur, the over-packed HLW melter will be stored at the WTP until facility closure, at which time it will be dismantled, packaged, and transported to a permitted Hanford TSD.

The details for the disposal of the LAW LSM and over-packed HLW melters are under development.

HLW Glass Residue

The disposal path for HLW glass residue that may be removed from an out-of-service HLW melter will be determined case-by-case. Final disposal will be based on the radionuclide content and dangerous characteristics of the glass residue.

Vitrified Waste Not Meeting Land Disposal Restriction Standards

Vitrified waste that does not meet the land disposal restriction standards will be stored at a Hanford Site TSD, pending corrective action determined on a case-by-case basis.

Melter Components

Melters will be fitted with ancillary equipment (such as bubbler assemblies, heating elements, and thermocouples) that may require periodic replacement. The ancillary equipment will be removed, designated by process knowledge as mixed waste, packaged, and transferred to an appropriate Hanford TSD.

Offgas Treatment System Components

The offgas treatment system will incorporate high-efficiency mist eliminators and high-efficiency particulate air (HEPA) filters to remove contaminants from the offgas streams before discharge. These components will be periodically replaced to maintain treatment efficiency. They will be designated as mixed waste by process knowledge, packaged, and transferred to an appropriate Hanford TSD.

Spent Carbon and Catalyst from Offgas Treatment

Spent carbon and catalyst from offgas treatment will be periodically replaced to maintain treatment efficiency. These materials will be designated by process knowledge and managed as mixed waste. They will be removed, packaged, and transferred to an appropriate Hanford TSD.

Spent Ion Exchange Resins

Ion exchange resins used to remove cesium and technetium will be periodically replaced to maintain treatment efficiency. These resins will be designated by process knowledge and managed as mixed waste. They will be eluted, removed from their respective columns, packaged, and transferred to an appropriate Hanford TSD.

Out-of-Service Equipment

Ancillary equipment such as pumps, valves, piping, motors, and electrical equipment that is no longer fit for use will be removed from service and designated as out-of-service equipment. Out-of-service equipment that has contacted the waste feed will be designated as mixed waste by process knowledge, packaged, and transferred to an appropriate Hanford TSD.

Entrained Solids

Entrained solids will be generated by pretreating the LAW feed using ultrafiltration. The separated solids will be washed and again concentrated using ultrafiltration. The entrained solids will be incorporated into either the immobilized high-level waste or the immobilized low-activity waste or returned via pipeline to the DST system unit as a slurry.

9.5.2.1.2 Variable Solid Waste Streams

The variable solid waste streams are listed in Table 9-2 and can be dangerous waste or mixed waste, depending on the source of the waste and if it had contact with the waste feed. EPA hazardous waste numbers and Washington State dangerous waste numbers will be assigned to these waste streams, based on the designation of the waste by process knowledge. In addition to the waste streams listed in Table 9-2, raw process materials and chemicals will be brought onto the WTP site. Some of these substances will subsequently become waste and will require characterization for proper waste management. The MSDSs provide the information necessary to properly characterize and designate a substance when it becomes a waste. Vendors will be required to provide MSDS for all substances brought onto the WTP site, and the WTP will maintain a MSDS file. Examples of these types of substances are process and laboratory chemicals, lubricants such as oils and greases, and maintenance products such as paints, solvents, and adhesives.

WTP subcontractors will be required to have MSDSs for the substances they bring onto the WTP site. Subcontractors will also be required to remove the residuals of any substance they bring onto the WTP site, including wastes generated such as wipes, paintbrushes, and personal protective equipment (PPE).

Each waste stream shipped for disposal by the WTP will meet the waste acceptance criteria of the receiving TSD.

Laboratory Waste

Non-wastewater laboratory waste derived from the waste feed will be designated as mixed waste by process knowledge, packaged, and transferred to an appropriate Hanford TSD. Other non-wastewater laboratory wastes, such as off-specification laboratory chemicals, will be designated by process knowledge and managed accordingly. These wastes will be packaged and disposed of at an appropriate TSD.

Personal Protective Equipment

Personnel performing certain tasks such as facility maintenance, treatment process operations, and waste packaging activities will wear PPE. Used PPE will be returned to the vendor for cleaning and refurbishment. PPE that cannot be recycled to the vendor and that has been in contact with waste feed will be designated as mixed waste by process knowledge, packaged, and transferred to an appropriate Hanford TSD. PPE waste that is not radioactive, but designated as dangerous waste by process knowledge, will be packaged and disposed of at an appropriate TSD.

Maintenance Waste

Maintenance wastes such as paints, lubricants, cleaning solvents, adhesives, and off-specification chemicals will be generated at the WTP. Maintenance wastes derived from the waste feed will be designated as mixed waste by process knowledge, packaged, and transferred to an appropriate Hanford TSD. Those not derived from the waste feed and designated as dangerous waste by process knowledge will be packaged and disposed of at an appropriate TSD.

9.5.2.2 Liquid Waste Streams

The dangerous liquid waste streams generated at the WTP will be managed in accordance with the *Hanford Site Liquid Waste Acceptance Criteria* (WMFS 1998). The Liquid Effluent Retention Facility (LERF) or the ETF, or both, will receive all hazardous aqueous waste generated at WTP. WTP will meet the acceptance criteria in the *Hanford Site Liquid Waste Acceptance Criteria*. The LERF and ETF will allow process knowledge to be used in lieu of some analyses (in instances where process knowledge is adequate), and a LERF or ETF representative will assist a WTP representative in identifying the waste acceptance criteria and analyses appropriate for characterizing the liquid waste. Each aqueous waste stream listed in Table 9-3 is discussed below.

The aqueous waste streams listed in Table 9-3 will be collected in an effluent collection tank. A grab sample will be taken by autosampler from the effluent collection tank to verify that the analytes meet the established waste acceptance criteria from the *Hanford Site Liquid Waste Acceptance Criteria* before transfer to the LERF or ETF.

Aqueous Waste from Processes

Table 9-3 lists the aqueous waste streams from processing. Aqueous waste streams will be generated by condensing offgas streams that will be in direct contact with or will be derived from the waste feed being processed. The LAW melter offgas scrubber blowdown, technetium process condensate, and technetium ion exchange rinse water will also be aqueous waste streams. The analytical laboratory will also generate aqueous waste. These waste streams will contain radioactive and dangerous waste components and will be similar to the process condensate stream described in the *Hanford Facility Dangerous Waste Permit Application, 242-A Evaporator* (DOE-RL 1997). These aqueous waste streams will be piped to the effluent collection tank before transfer to the LERF or ETF by underground pipeline for treatment.

Plant Wastewater

Wastewater will be generated primarily from decontamination and washdown activities in the WTP. The wastewater will be designated as mixed waste by process knowledge, since it will contain dilute waste feed constituents. Wastewater will also be piped to the effluent collection tank before transfer to the LERF or ETF.

9.6 Waste Handling or Treatment Systems

No newly generated wastes are expected to be treated at the WTP. The waste will be collected, characterized, placed in the appropriate waste containers, and transferred to Solid Waste Disposal for treatment, packaging, and disposal offsite or to the appropriate onsite facility. Regulated wastes will be shipped to the appropriate storage or disposal facility within 90 days of accumulation.

9.7 Environmental Radiological Protection Plan

A draft of the Environmental Radiological Protection Plan (ERPP) (*WTP Environmental Radiological Protection Plan-DRAFT*, 24590-WTP-PL-ENV-01-006) will be submitted with the preliminary safety analysis report. A final ERPP will not be completed until the necessary permit applications have been approved and appropriate procedures completed. The ERPP will not address the non-radiological waste, but will be confined to the following areas:

- Radiation protection for the public and the environment
- Radiological effluent control and monitoring
- Radiological waste management
- Environmental radiological monitoring

Much of the information required by the ERPP already exists or will exist in other documents. For example, many of the radiological protection requirements are addressed in the Radiation Protection Plan. Similarly, most of the effluent control monitoring and environmental monitoring activities required under the various environmental permits are identified in the Environmental Plan. The ERPP will reference existing documentation whenever possible as the means for satisfying the requirement. For those requirements not addressed elsewhere, the ERPP will describe how the requirements are satisfied.

9.8 References

Project Documents

24590-WTP-DWPA-ENV-01-001, *RPP-WTP Dangerous Waste Permit Application*.

24590-WTP-PL-ENV-01-006, *WTP Environmental Radiological Protection Plan*, Draft.

24590-WTP-SRD-ESH-01-001, *Safety Requirements Document.*

PL-W375-EN00012, *River Protection Project-Waste Treatment Project Environmental Plan.*

Codes and Standards

40 CFR 52.21. "Prevention of significant deterioration of air quality," *Code of Federal Regulations.*

40 CFR 61. "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations.*

40 CFR 264. "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations.*

AEA 1954. *Atomic Energy Act of 1954,* 42 USC Sect 2011, US Congress, Washington, DC.

CAA. 1970. *Clean Air Act,* 42 USC Section 1704, US Congress, Washington, DC.

CWA. 1977. *Clean Water Act,* 33 USC Section 121, US Congress, Washington, DC.

DOE 1996. *Final Environmental Impact Statement for the Tank Waste Remediation System,* DOE/EIS-0189, Summary and Volumes 1-6, August 1996, US Department of Energy, Washington, DC.

DOE-RL. 2000. *Pollution Prevention and Best Management Practices Plan for State Discharge Permits ST 4508, ST 4509, ST 4510,* DOE-RL-97-67, US Department of Energy, Richland, Washington.

DOE-RL. 1997. *Hanford Facility Dangerous Waste Permit Application, 242-A Evaporator,* DOE-RL-90-42, US Department of Energy, Richland, Washington.

Ecology. 2001. *Hanford Site Air Operating Permit,* March 2001, Washington State Department of Ecology, Washington State Department of Health, Olympia, Washington.

Ecology. 1999. *Site-wide Industrial Stormwater Discharges to Engineered Land Disposal Structure Permit,* ST 4510, Washington State Department of Ecology, Olympia, Washington.

Ecology. 1998. *Site-wide Cooling Water and Condensate Discharges Permit,* ST 4509, Washington State Department of Ecology, Olympia, Washington.

Ecology. 1997. *Site-wide Hydrotest, Maintenance, and Construction Discharges Permit,* ST 4508, Washington State Department of Ecology, Olympia, Washington.

Ecology. 1994. *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste,* Permit Number WA7890008967. Washington State Department of Ecology, Olympia, Washington.

EPA. 1997. *Test Methods for Evaluating Solid Waste Physical/Chemical Methods,* SW-846, US Environmental Protection Agency, Washington, DC.

EPCRA. 1986. *Emergency Planning and Community Right-to-Know Act of 1986,* 42 USC Section 11001, US Congress, Washington, DC.

RCRA. 1976. *Resource Conservation and Recovery Act of 1976,* 42 USC Section 6901, US Congress, Washington, DC.

RCW. 1976. *Hazardous Waste Management Act of 1976,* Revised Code of Washington 70.105, Olympia, Washington.

WAC 173-216. "State Waste Discharge Permit Program," *Washington Administrative Code.*

WAC 173-303. "Dangerous Waste Regulations," *Washington Administrative Code.*

WAC 173-400. *General Regulations for Air Pollution Sources,* Washington Administrative Code.

WAC 173-460. *Controls for New Sources of Toxic Air Pollution,* Washington Administrative Code.

WAC 246-247. "Radiation Protection-Air Emissions," *Washington Administrative Code.*

WAC 246-272. *On-Site Sewage Systems,* Washington Administrative Code.

Other Documents

HNF. 1998. *Hanford Site Solid Waste Acceptance Criteria,* HNF-EP-0063, Revision 5, June 1998, Fluor Daniel Hanford, Inc., Richland, Washington.

WMFS. 1998. *Hanford Site Liquid Waste Acceptance Criteria,* HNF-3172, Revision 0, September 1998, Waste Management Federal Services of Hanford, Inc., Richland, Washington.

Table 9-1 Secondary Solid Mixed Waste Streams

Waste Stream	Disposal	Characterization
Out-of-service melters	[a]	Designated by process knowledge
HLW glass residue	Determined case-by-case	
Vitrified waste not meeting LDR[b] standards		
Melter components	These wastes will be packaged and transferred to the appropriate Hanford TSD.	
Offgas treatment system components: high-efficiency mist eliminators HEPA filters		
Spent carbon and catalyst from offgas treatment		
Spent ion exchange resins		
Out-of-service equipment		
Entrained solids	[c]	

a Disposal of out-of-service melters is under development

b Land Disposal Restrictions

c Entrained solids may be returned to the DST system unit via pipeline as a slurry or added to the LAW or HLW feed for vitrification

Table 9-2 Variable Solid Waste Streams

Waste Stream	Characterization	Disposal
Non-wastewater laboratory waste	Each generation event of these wastes will be designated by process knowledge and will comply with the receiving TSD waste acceptance criteria	The wastes will be packaged and transferred for disposal to an appropriate TSD
Personal protective equipment		
Maintenance waste		

Table 9-3 Liquid Mixed Waste Streams

Waste Stream	Characterization and Disposal	Sampling Point	Sampling Frequency
LAW feed evaporator condensate	The waste streams will collect in a mixer tank, be designated as mixed waste by process knowledge and analysis, as necessary, and transferred to the LERF or ETF.	The streams collected in a mixer tank are grab sampled by autosampler.	Sampling will be: • Before initial discharge • At major process change • At request for resampling by the ETF
LAW melter feed evaporator condensate			
HLW offgas condensate			
LAW melter offgas scrubber blowdown			
Technetium process condensate			
Technetium ion exchange rinse water			
Laboratory wastewater			
Plant wastewater containing waste feed			

10 Initial Testing, In–Service Surveillance, and Maintenance

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10 Initial Testing, In–Service Surveillance, and Maintenance

10.1 Introduction

This chapter describes essential features of the commissioning (initial testing) program, readiness (pre–operational safety) review program, in–service surveillance program, and maintenance program implemented at the River Protection Project – Waste Treatment Plant (WTP) facilities. Discussions in this chapter demonstrate that a well–defined program with a commitment to testing, surveillance, and maintenance is an integral part of the WTP's overall safety–assurance philosophy.

- The commissioning program ensures that, at the time of initial operation, structures, systems, and components (SSCs) function as designed.
- The readiness review program verifies that the hardware, programs, and personnel are in place and effective in supporting safe operations of the WTP facilities.
- The operational surveillance and maintenance programs help ensure that SSCs are available and perform as designed when needed.

10.2 Requirements

Safety Requirements Document

Chapter 6, "Startup," Safety Criteria 6.0–1 through 6.0–5

Chapter 7, "Management and Operations," Safety Criterion 7.0–3

Section 7.6, Maintenance, Safety Criteria 7.6–1 through 7.6–4

Section 7.9, Quality Assurance Program, Safety Criteria 7.3–7, 7.3–8, 7.3–11

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 10
1.5	Commissioning and Operation	Chapter 10, "Initial Testing, In-Service Surveillance, and Maintenance"
1.5	Commissioning	10.3, "Commissioning"
1.5	Mechanical Integrity	10.5, "Maintenance"
1.5	Commissioning Review	10.3, "Commissioning"

10.3 Commissioning

The WTP commissioning program, an integral part of the project's safety approach, will validate that the design, construction, hardware, programs, and personnel are ready to support safe facility operation. Tests will be performed to

- Ensure that the safety design class and safety design significant SSCs and other significant facility equipment are properly built and will operate as designed, within safety limits, before transition to the operational phase.
- Document the as-built configuration and the initial operating parameters of the facility.
- Confirm the adequacy of training, procedures, and conduct of operations for facility operation.
- Serve as an opportunity to perform a final system analysis and to detect significant faults before facility operations begin.

10.3.1 Testing Program Description

A WTP commissioning transition plan will be prepared to describe the overall safety, technical, and management philosophy of the WTP testing program. This plan will

- Address the processes for construction turnover, component and system testing leading to integrated process testing (water runs, simulant runs, and environmental performance testing).
- Address the processes to demonstrate readiness for hot commissioning.
- Establish the responsibilities and relationships of organizations participating in commissioning.
- Serve as the basis for development of the WTP Startup Manual (SUM).

The WTP commissioning program will be based on a phased testing approach that will take individual components and items of equipment and systems through progressively higher levels of testing. This will begin with simple component tests, move to more complex tests at the system level, then to integrated tests at the facility level. Each level of testing is designed to confirm that the structures, personnel, procedures, equipment, services, and utilities are ready to perform their design function with active waste.

The phased approach is based on initially selecting systems that are independent in operation (primarily utilities) and are required to support the major process systems. The commissioning of these independent support systems leads to the testing and commissioning of more critical and complex systems. Once the systems are tested individually, integrated testing of the facility is conducted. This strategy provides a logical and systematic approach to the startup of the facility and will be followed through to the completion of hot operations testing. The same approach to testing is used for each WTP facility. The WTP testing phases are

Phase 1 - Construction testing (installation checks)

Phase 2 - Systems commissioning (component level and systems, using water)

Phase 3 - Integrated water runs (integrated systems testing, using water)

Phase 4 - Cold commissioning (integrated systems testing using reagents and simulants for pretreatment, low-activity waste, high-activity waste)

Phase 5 - Hot commissioning (introduction of active waste)

The SUM will incorporate the requirements of the WTP *Quality Assurance Manual* (QAM), 24590-WTP-QAM-QA-01-001, for testing, personnel qualifications, and record management. It will require that test plans be developed to outline the objectives, prerequisites, precautions, and acceptance criteria. The technical content of the test plans will be derived from design criteria, process descriptions, and engineering specifications. Detailed test procedures will implement the technical and safety requirements of the test plans and the management controls required by the SUM. They will also provide a summary of test results, confirm that these results are acceptable from the safety and technical viewpoints, and demonstrate that the tested process meets the design intent.

Test plans and procedures are developed, reviewed, and approved in accordance with the SUM. The SUM will also describe strict testing controls, including:

- Test prerequisites identification and verification
- Data collection and recording
- Control and resolution of test deficiencies
- Control of test changes
- System and process fault tracking and resolution
- Equipment maintenance or modifications during testing
- Evaluation of test data

Changes to the baseline, approved design, or WTP procedures will be controlled by formal project procedures that clearly define the process for change control. Changes will be screened to determine if they affect the Authorization Basis. Changes in the Authorization Basis will be screened to determine if they affect project design, requirements, or procedures.

The SUM will also describe the functioning of the joint test group (JTG) for each facility. The JTG will consist of experienced personnel who have knowledge of the WTP processes and who have backgrounds in testing, operations, engineering, quality assurance, or other areas required to oversee the test program. The qualifications, duties, and responsibilities of the JTG will be specified in the SUM. Responsibilities of the JTG will include review and approval of:

- Test plans
- Test procedures before they are performed
- Results of completed test procedures
- Major changes to approved test procedures
- Commissioning results reports

Operations, commissioning, and support personnel will be trained in accordance with the requirements of the WTP training and qualification program (see section 12.4 of this General Information volume). Training will be assessed against the readiness requirements to ensure that personnel are trained and qualified to meet the requirements of each phase of the testing and commissioning program.

10.3.2 Construction Testing

Construction testing activities are the major activities required for achieving physical completion before system turnover to the testing organization. Construction testing will include activities such as hydrostatic testing of fluid systems, nondestructive examination of welds, and megger checks of electrical components.

In some cases, in particular for the balance of facilities, a component or system may be made fully operational by a vendor before it is turned over to the commissioning organization. To minimize the testing effort, credit will be taken, where possible, for vendor testing that is performed in accordance with project program requirements and approved by the commissioning organization. Some additional testing may be required by the commissioning organization to demonstrate system functionality and integration with other facilities/processes. Commissioning personnel may witness some construction testing, but in all cases, they will review construction test documentation before system turnover from construction.

10.3.3 System Commissioning

During system commissioning, engineering requirements (including control, electrical, instrumentation, mechanical, process, and services) will be tested. Components within a system will be checked first to verify that the component is functional. These checks will include direction of rotation and motor run-in, circuit breaker checks, instrument calibrations, valve stroke checks, control loop checks, and system flushing.

Following component testing, the systems will be tested to verify that they perform in accordance with system design requirements and acceptance criteria established by engineering. All system attributes that can be tested under these conditions will be checked. Components designed for remote removal will be verified to be removable and reinstalled.

Once a system is turned over from construction to the testing organization, suitably trained plant operators will be used as much as possible to manipulate the equipment and controls during conduct of the startup test procedures. This will reinforce the operator training with hands-on experience, and allow operations personnel to become knowledgeable in the features and limitations of systems and components. Test procedures will also use portions of or entire operating procedures where feasible, so that procedures can be validated early, and lessons learned from the testing program can be incorporated.

10.3.4 Integrated Water Runs

During integrated water runs, testing will progressively expand the functionality of the plant; confirm control, safety, and plant protection features; and perform full system throughput trials with water before the introduction of reagents and simulants. Each system will be tested to demonstrate performance, and will only be integrated with other systems after test acceptance criteria (including interface criteria with supported or supporting systems) have been met.

As far as possible the integrated water runs will confirm the WTP as a fully integrated facility, specifically:

- Systems will be balanced at full design throughputs to demonstrate that the process can be continuously operated without interruptions or generating backlogs

- Sequences will be demonstrated
- Control systems will be placed in service

Operating and maintenance procedures and instructions will continue to be subject to validation during the integrated water runs.

10.3.5 Cold Commissioning

For cold commissioning the processing facility will be operated, as much as possible, using simulated feeds that chemically duplicate the eventual introduction of radioactive feeds (except for noble metals and rare earths). This simulant testing will demonstrate the normal flow of feed material from the pretreatment to the low–activity waste and high–level waste facilities. Each facility will be tested using a gradual approach, with individual systems coming on line, followed by integrated process testing. After a preparation and ramp–up period, the facility will be tested using simulants to demonstrate that

- The plant performs in accordance with environmental, operational, and safety performance requirements.
- The plant will meet the capacity criteria in accordance with process flowsheets and design and process descriptions.

Before the reagents and simulants needed for cold commissioning and subsequent testing are received, a readiness self–assessment will be satisfactorily completed (see section 10.3.7). During cold commissioning tests, additional sampling will be required to ensure that product qualification and secondary waste requirements are met. The analytical laboratory facility and all sampling operations will be tested and operational to support cold commissioning.

The operations organization will play the principal role in operating the WTP facility during cold commissioning. Operating and maintenance procedures and instructions will be implemented and validated during these tests. Cold commissioning testing will establish baseline operating data for all major facilities and will exercise all facility systems in support of hot commissioning. Following production–type testing, off–standard operational testing will be conducted. During this testing, the input of simulated waste will be increased in small increments and the response of the systems and facility will be recorded. Any process deviations from a stable condition will be the basis for setting the maximum safe operating limits for the systems and the facility as a whole.

Tests will also be conducted to simulate process incidents such as loss of power, loss of services, or loss of control system. The response of the process, personnel, and procedures will be recorded and evaluated.

As an element of cold commissioning, an environmental performance demonstration will be conducted for each process facility, verify that it meets federal and Washington State requirements for the removal of hazardous constituents from facility effluents.

10.3.6 Hot Commissioning

Hot commissioning signifies the first transfer of radioactive materials from the tank farms to the WTP, and will begin the stabilization and reduction of stored radioactive tank waste. Before hot commissioning begins,

- All previous phases of the commissioning program will be designed and performed, to ensure that it is safe to proceed to radioactive operations.
- Each facility will be restored to its permanent state, and temporary equipment, facilities, and inputs will be removed.

A deliberate approach to full operations will be observed during hot commissioning. Plant equipment and systems will gradually be brought on line while the systems, components, and controls are confirmed to operate as expected with active waste. Following this preparation and ramp–up period, the facilities will be performance tested to demonstrate that the plant performs in accordance with design requirements. Hot commissioning testing will establish additional baseline operating data not obtained during previous testing phases.

For hot commissioning, the facilities will be run by, and under the full control of the operations organization. The testing organization will be responsible for ensuring that all hot commissioning tests are carried out and the results evaluated for acceptance.

10.3.7 Readiness Reviews

When integrated water testing for each facility is almost complete, and before initial processing with hazardous chemicals, independent WTP assessors will conduct a readiness self–assessment, to confirm that:

- Testing has adequately demonstrated that equipment and processes are ready to move to the next phase of testing without undue risk to workers, the public, or the environment.
- Facility personnel are ready (training, qualifications, staffing levels).
- Procedures are current and that they reflect lessons learned.
- The required programs and management controls are in place to adequately control the next phase of testing and operation.

Findings identified during this self assessment will be tracked through resolution and closure.

Before initial processing of radioactive waste, an internal pre–operational safety assessment will be conducted. This review will

- Assess readiness to start operations.
- Ensure that the facility can begin operation without undue risk to workers, the public, or the environment.

The review will be performed by personnel independent of the operating and testing staffs. It will focus on the adequacy of hardware, personnel, and administrative programs. Findings will be tracked through resolution and closure.

The systematic approach used during this review will include identifying detailed attributes for each facility preparation activity to be evaluated, and identifying acceptance criteria for each attribute. The pre–operational review process includes evaluating areas selected from the following attributes:

- Safety Documentation
  - An adequate process hazards analysis is performed and resultant recommendations are adequately incorporated
  - Important to safety (ITS) systems are defined and a configuration management process is applied to maintain control over the design and modification of these systems
  - Final Safety Analysis Report (FSAR) commitments have been satisfied
- Personnel
  - Sufficient operations personnel are trained and able to support safe facility operations
  - Management programs are established, sufficient number of personnel are provided, and adequate facilities and equipment are available to ensure that operational support services (such as training, maintenance, waste management, environmental protection, industrial safety and hygiene, radiological protection and health physics, emergency preparedness, fire protection, quality assurance, criticality safety, and engineering) are adequate
  - The level of knowledge of operations and operations support personnel is adequate, based on reviews of examinations and examination results and interviews of selected operations and operations support personnel
  - Management programs promote staff awareness of worker and public safety, health, and environmental protection requirements, and promote staff commitment to comply with these requirements
  - Functions, assignments, responsibilities, and reporting relationships are clearly defined, understood, and effectively implemented (with line management responsibility for control of safety)
- Hardware and Systems
  - All systems are operable and in satisfactory condition, and a program is in place to confirm and periodically reconfirm the condition and operability of ITS systems (including examination of test records and calibration of these systems)
  - A test program that confirms operability of equipment, the viability of procedures, and the training of operators, and confirms that construction and equipment have been designed in accordance with design specifications
  - Modifications to the facility are reviewed for potential impacts on procedures, training, and safety basis
- Programs and Procedures
  - Adequate and correct procedures are in place for operating the facility
  - Training and qualification programs encompassing the range of duties and activities to be performed are established, documented, and implemented for operations and operations support personnel
  - Adequate and correct emergency and maintenance procedures are in place
  - An emergency operations drill and exercise program is implemented, including necessary memoranda of understanding and program records
  - A process is established to identify, evaluate, and resolve deficiencies and recommendations made by oversight groups, official review teams, and audit and assessment organizations

- Regulatory Compliance
  - A systematic review of the facility's conformance to applicable federal and state requirements is performed, potential nonconformances are identified, and schedules for achieving compliance are justified in writing and formally approved

The Project Safety Committee will approve the results of this review before the WTP will certify to the US Department of Energy (DOE) Office of River Protection that the project is ready for operation with active waste.

10.4 Surveillance Program

The WTP surveillance program is designed to ensure the integrity of facility systems and that safety systems perform their function of protecting the health and safety of the public, workers, and facility staff by preventing or mitigating accident consequences. Surveillance of designated facility equipment and systems ensures that technical safety requirement (TSR) surveillance requirements will be met. Chapter 5 of the FSAR facility–specific volumes and the related Bases Appendices for these TSRs will explain how each TSR surveillance requirement (test, calibration, or inspection of plant equipment) demonstrates operability to fulfill limiting condition for operations or limiting control setting requirements. The analyses documented in Chapter 3 of the FSAR facility–specific volumes will define the numeric setpoints and values associated with each TSR surveillance requirement.

The surveillance program will be conducted in conjunction with the WTP maintenance and operations programs (including scheduling and tracking). Surveillance procedures providing in–the–field instructions for systematic inspection, testing, calibration of plant equipment, or plant data readings will be prepared in accordance with Project administrative procedures. These in–the–field procedures will contain detailed performance criteria and sections to record as–found conditions and test results. The WTP Computerized Maintenance Management System (CMMS) and operational round sheets and data will record surveillance test data.

Figure 10–1 is a flowchart illustrating the major steps in the surveillance testing process. WTP administrative procedures will describe the responsibilities for administering and using the tracking and scheduling process, including forecast reporting, overdue surveillance reporting, preparing work packages, and generating notices of discrepancies. These procedures will require that assigned personnel perform a periodic assessment of required scheduled surveillance tests against actual performance to identify anomalies that could lead to violations of the TSR surveillance requirements and to determine the overall effectiveness of the TSR compliance process.

The WTP will normally perform TSR surveillances while the affected systems are not in operation or when redundant equipment is operational. If surveillance testing or calibration is required while affected ITS systems must be operable, surveillance procedures will identify compensatory actions (where applicable) that are acceptable during the short time that the surveillance activities are being performed. Limiting conditions for operation 3.0.7, "Response to LCO–Violation," defines actions to be taken when a failure to comply with TSR requirements is identified. WTP administrative procedures will describe the processes for determining the root cause of the violation, identifying corrective actions to prevent recurrence, and notifying Project and DOE/Office of Safety Regulation personnel.

WTP administrative procedures will describe the requirements for, and the process used for trending of surveillance test results. Operations supervision will be responsible for reviewing surveillance test results. Plant engineers will use the CMMS database for the analysis of equipment history and system performance trends.

Inspections, audits, reviews, investigations, and assessments are necessary for an effective surveillance program. Title 10, *Code of Federal Regulations,* Part 830, "Nuclear Safety Management," (10 CFR 830) Subpart A, Quality Assurance, requires management assessments to identify problems that hinder the organization from achieving its objectives. In addition, section 10.5.10, below, requires that senior managers periodically review and assess elements of the maintenance program to assist line managers and supervisors to identify and correct program deficiencies. A project administrative procedure will define the management assessment process for WTP facilities. This procedure will require the manager responsible for the TSR surveillance program to periodically assess field implementation of the program and implement changes in the program in accordance with project procedures.

Section 10.5.13, below, discusses the control and calibration of measuring and test equipment (M&TE) for the maintenance program. This discussion also applies to M&TE used for in–service surveillance.

Section 12.4, Training and Qualification, discusses training of personnel, including personnel who perform in–service surveillance calibration and testing.

10.5 Maintenance

The WTP facility maintenance program ensures that the reliability and effectiveness of facility ITS SSCs remain in accordance with design requirements. This ensures that facility safety is not adversely affected by maintenance activities. The ITS SSCs relied on to protect workers and the public, and the respective maintenance and surveillance actions assigned to these SSCs and related activities, are included in the program. Chapter 3, "Hazards and Accident Analyses," describes the process that identified these SSCs and related activities as being required to prevent or mitigate the consequences of radiological or chemical releases. Chapter 4 of the facility–specific volumes discusses the rationale for selection and scheduling of the maintenance and TSR surveillances for these SSCs and human actions.

In addition to the maintenance and surveillance activities in Chapter 5, the maintenance program includes additional maintenance to maintain the integrity of process equipment, to support reliable facility operation, and to protect investments. The safety application of maintenance policies and procedures to a particular facility item will be based on design classification of DOE orders and directives and appropriate *Code of Federal Regulations* requirements. Experience from the Defense Waste Processing Facility and West Valley, as well as best engineering practices will be applied to WTP maintenance activities. A graded approach will be applied to maintenance activities in accordance with procedures and policies accepted throughout the DOE complex.

Maintenance includes those functions performed primarily by mechanical, electrical, and instrument and control personnel. Maintenance includes servicing, overhaul, repair, and replacement of parts, functional testing, calibration, inspection and monitoring; and testing, calibration, and monitoring performed by personnel to comply with the TSR surveillance requirements. In addition, certain activities involved in the modification of SSCs are performed under maintenance program controls, which supplement the configuration management controls (described in the configuration management program).

The WTP design incorporates features to minimize the need for replacement or overhaul activities, and the amount or duration of hands–on maintenance of equipment exposed to radioactive or potentially radioactive material. These design features, based on lessons learned from operating processing facilities such as Defense Waste Processing Facility and West Valley, include:

- The use of specially designed, high–integrity, remotely removable, and replaceable pumps and valves in process systems, where appropriate.
- The use of equipment with no moving parts (such as air lifts, ejectors, fluidic pumps, and reverse flow diverters).
- The ability to empty vessels and the provision of in–vessel wash systems.
- The ability to remove equipment to designated decontamination and maintenance areas.
- The positioning of in–cell maintainable equipment in shielded access areas.
- The choice of long–lived construction materials.
- The choice of vessels and piping of dimensions and thickness that minimize the possibility of failure during the life of the facility.
- The application of appropriately designed tools and equipment.

Personnel with maintenance and operational experience at other waste processing plants provide input to the design organizations so that the final WTP facility design reflects current industry knowledge.

The WTP facility maintenance program also uses appropriate maintenance and inspection frequencies, procedures, training, and operational practices to ensure that exposure to personnel is maintained as low as reasonably achievable (ALARA).

10.5.1 Maintenance Organization and Administration

Well–defined, effectively administered maintenance policies and programs optimize facility operations. Written procedures for the WTP facilities will provide direction to effectively implement and control maintenance activities. Issues covered in the written procedures will include assigning responsibilities and authority, controlling interfaces with other facility organizations, and addressing daily functioning of the maintenance organization. Facility management and work control procedures will ensure that maintenance work is close coordinated with such organizations as operations, engineering, radiological protection, quality assurance, and industrial safety. The Integrated Safety Management System is a major component of the work control process to ensure that all organizations associated with maintenance work have clear input into its performance. The Integrated Safety Management System is described in the *Integrated Environment, Safety and Health Management System Program Description*, 24590–WTP–PL–ENV–01–003 (Draft).

Performance indicators and a trend process will be used to monitor the effectiveness of the maintenance organization, program, and the performance of ITS SSCs. Problems, incidents, and unplanned occurrences that affect safety or reliability will be analyzed. Corrective actions identified by these analyses will be implemented to improve the maintenance program. Lessons learned from deficiencies will be communicated to waste process industry sources, and information from lessons learned at other industry sites and across the DOE complex will be evaluated for applicability to the WTP.

Maintenance supervisors will monitor work in progress to ensure that maintenance activities are conducted in accordance with approved procedures and work packages. Supervisors will stress personal accountability for industrial safety, radiological protection practices, the use of procedures, and quality workmanship. Subcontractor personnel performing maintenance on WTP SSCs will work under maintenance program procedures and controls. (The FSAR will provide a detailed description of the maintenance organization, roles, and responsibilities.)

10.5.2 Types of Maintenance

Facility surveillance testing and preventive, predictive, and corrective maintenance practices will ensure that equipment degradation is identified and corrected, equipment life is optimized, and radiological exposure to maintenance personnel is minimized. On ITS systems and equipment, a thorough technical analysis will be used to establish the frequency and types of maintenance. On non–ITS systems and equipment, the frequency and type of maintenance will be in accordance with codes and standards, engineering judgement, and vendor recommendations. Planning and analysis to determine the frequency and types of maintenance will be an iterative process. The results of equipment history trends, predictive maintenance results, and changes in radiological conditions are a few of the factors to be used to modify maintenance practices for individual systems and components. The results of these analyses and a plant item list will be major inputs to the CMMS.

Design of safety instrumented systems (SIS) will account for maintenance and testing to maximize the accuracy and health of WTP instrumentation, while not depriving operating systems of protection. *Application of Safety Instrumented Systems in the Process Industries* (ISA S84.01) will be the standard driving SIS design, implementation, and testing. To minimize SIS downtime, any SSC in the SIS loop will be designed so that it does not require frequent adjustment or calibration. This will be true of instrument sensors, any of the methods used to providing interlocking logic, and the final actuated equipment. For instrument sensors, preventive maintenance will typically consist of calibration and adjustment. Some SIS components (the Programmable Protection System, for example) will have self–diagnostic capabilities to warn when a component is not healthy. This sort of diagnostic capability will require no detectable downtime and will be a valuable tool to ensure that the Programmable Protection System is one of the most reliable components in the SIS loops. SIS loop design will also include components to facilitate simple, quick procedures for required calibration, preventive maintenance, and testing. Additional detail of SIS design is in Chapter 2 of the facility–specific SAR volumes.

Categories of maintenance at the WTP facility include the following.

- Preventive Maintenance – Includes periodic and planned maintenance actions to maintain ITS equipment within design operating conditions and to extend its life. Preventive maintenance is performed before equipment failure or to prevent equipment failure. This includes TSR surveillances, in–service inspections, and other regulatory forms of preventative maintenance, and periodic activities such as external inspections, alignments or calibrations, internal inspections, overhauls, vendor recommended tests, and planned equipment replacement.
- Predictive Maintenance – Includes diagnostic monitoring to forecast component degradation so that planned maintenance can be performed as needed before equipment failure. This includes continuous or periodic monitoring where a type of equipment failure is compatible with predictive maintenance techniques.
- Corrective Maintenance – Includes tasks required to repair or replace failed or malfunctioning equipment. Corrective maintenance will be governed by the planning, scheduling, and implementation processes described in section 10.5.3. The cause(s) for the failure or malfunction will be identified, corrected, and documented in the equipment history files described in section 10.5.7.

Corrective maintenance will be accomplished in a timely manner based on consideration of plant objectives and the relative importance of the equipment.

- Modifications – Includes tasks necessary to rectify component failures discovered during maintenance, repair components after failures in operation, reduce the frequency of faults, and incorporate non–identical replacement items or a new design. Facility modification work, including temporary modifications, will be accomplished under the same basic administrative controls applied to facility maintenance activities, and will maintain the configuration management controls described in the configuration management program. The WTP facility will implement a program to control and track temporary modifications (including temporary repairs). This program will stress the need to minimize the number and duration of temporary modifications and will require that temporary modifications be adequately identified, reviewed, approved, documented, and periodically reassessed for continued applicability. This review will ensure that the modification does not unacceptably alter or degrade the original design, facility safety, or reliability. Major modifications will be implemented under engineering and construction requirements and procedures up to the point where they are integrated with other facility systems and equipment; thereafter, facility maintenance procedures will control the activities.

10.5.3 Maintenance Planning and Scheduling

Maintenance management will ensure that an effective system for planning, scheduling, and coordinating maintenance activities is implemented. This system will

- Minimize the impact of maintenance activities on facility operations
- Increase equipment availability
- Improve maintenance efficiency
- Reduce radiation exposure
- Ensure that maintenance activities are done promptly

A graded approach that uses the work control process and maintenance planning will govern maintenance related work. The level of planning for any work package will be determined by the safety significance of the equipment, the complexity of work being performed, the potential radiological or other safety hazards, and the level of coordination needed between organizations. Maintenance work planning has the following benefits:

- Ensures that necessary work items are identified (such as instructions, special tools, qualified personnel, and repair parts and materials)
- Reduces delays
- Helps ensure efficiency
- Contributes to keeping the facility in a condition that improves facility availability

Some maintenance planning group functions include:

- Define work scope. This may be accomplished by work site inspection, review of preventive maintenance activities, operations requirements, and so on. The work control process will identify the need for work to be done.

- Identify approved procedures, drawings, vendor manuals, maintenance history, and data needed to analyze the maintenance problem.
- Initiate procurement of necessary parts, materials, tools, and equipment.
- Assess staffing and skills requirements for facility, nonfacility, and subcontractor personnel
- Review other, concurrent scheduled work
- Pre–job, ALARA, and hazards analysis planning
- Identify initial conditions and prerequisites, including applicable TSRs, limiting conditions for operations, and compensatory actions for equipment removed from service
- Identify quality control inspection, codes, and standards requirements
- Review work packages for completeness
- Review work activities to verify that the Authorization Basis is not compromised

Maintenance activities will be scheduled using a scheduling tool. Each preventive maintenance action will be scheduled at the appropriate interval and time, and combined (when possible) with corrective maintenance or surveillance activities. The appropriate skills mix and craft availability will also be considered. The schedule will reflect the work priority, as determined by the operations organization, so that work related to personnel safety, plant safety, or protection of the environment receive priority. The schedule will reflect the needs of plant operations for production efficiency. This schedule will be published in advance of work activities so that interfacing personnel are aware of the activities and prepared for their portion of the work.

When the task is completed, completed work packages will be reviewed to ensure proper documentation, adequate post–maintenance testing, and entry of maintenance results into CMMS. Reviews of defects found or adjustments made and the identified cause of the defect or adjustment are particularly important. The results of surveillance testing are reviewed for completeness, accuracy, and compliance with regulatory requirements. Operations supervision will compare the work accomplished to the post–maintenance testing or inspections results, and determine that the work is acceptable before returning the equipment or system to normal service.

10.5.4 Maintenance Procedures

Maintenance and surveillance activities will be controlled by procedures or work orders to ensure that they are performed safely and efficiently. Written guidance, craft skills, and work–site supervision will be used to achieve quality workmanship. All work that could result in a deviation from the authorization basis, in a significant process transient, in degraded facility reliability, or in a significant hazard to personnel or equipment will require using detailed maintenance or surveillance procedures. Work complexity will also be a factor in determining the need for a procedure. Work directions will be technically accurate, complete, up–to–date, and presented in a clear, concise, and consistent manner to minimize human error.

Maintenance procedures will be prepared and controlled based on WTP Project administrative procedures (see section 12.3, Procedure Program). Designated maintenance procedures will be verified and validated. Verification is a review to ensure that a procedures (new or revised) is in the proper format and is technically accurate, and that the format incorporates human factors principles and other appropriate administrative policies. The validation process ensures that the procedure provides sufficient and understandable guidance and direction, and that the procedure is compatible with the equipment or system being maintained. Validation typically will be performed in the field before the procedure is used.

Compliance requirements will be clearly stated in the procedure, or provided as general administrative guidance, and will be addressed in the maintenance training program.

10.5.5 Post–Maintenance Testing

Post–maintenance testing (PMT) will be conducted, commensurate with the work performed and the equipment's importance to safety and reliability, to ensure that the original deficiency has been corrected and that components fulfill their design function when returned to service. PMT ranges from simple tasks (such as verifying that a replaced valve does not leak) to detailed in–depth diesel generator performance tests. PMT control and documentation will be addressed in administrative procedures and will be part of the work order process. PMT will be addressed after all corrective maintenance. PMT instructions will address all applicable codes and TSRs, plus any additional applicable testing requirements, and will describe acceptance criteria, data recording, and special documentation requirements. The intent of PMT instructions for major maintenance activities on ITS SSCs will be to simulate upset conditions and demonstrate that appropriate SSCs are available and reliable, and function as intended. The operations organization will be responsible for coordinating test performance after major maintenance activities and for ensuring that equipment is declared operable only when PMT has been completed satisfactorily.

10.5.6 Maintenance Training and Qualification

A maintenance training and qualification program develops and maintains the skills and knowledge that personnel need to effectively perform maintenance and surveillance activities. Programmatic aspects of the maintenance training program are described in section 12.4, Training and Qualification. Qualification requirements for maintenance employees will include a combination of education, experience, and job– and task–specific training. Maintenance management is responsible for proper training and for evaluating and continually improving the training program for their staff, including management and supervision. Training will specifically address employee orientation and emergency procedures, health and safety, occupational radiation protection, environmental protection, specific craft skills associated with assigned tasks, ITS systems training, and administrative controls. The ITS systems training will cover system function, construction, operations, and supporting services. Training will stress the safety importance of maintenance tasks and the potential safety consequences of technical or procedural errors. Qualification evaluations and training examinations will verify that maintenance staff possess the skills and knowledge to perform maintenance on ITS SSCs. Stop–work authority will be included in the training, to ensure safety.

Non–facility contractor personnel who perform maintenance or modifications on facility systems will be trained and qualified for the work they are to perform. Maintenance contractor training will include general employee training and training in administrative controls, quality assurance, safety, and radiation protection, as appropriate.

10.5.7 Maintenance History

Maintenance program procedures will require that maintenance personnel both record the actual work performed and describe the conditions found during maintenance. This data will provide historical information for maintenance planning, for performance trending of systems and components, and for identifying needed maintenance program improvements. Trending information will also be used to identify measures (such as changes to the frequency of preventative maintenance, and equipment modifications) to improve facility reliability. WTP administrative procedures will describe the specific types of data to be maintained and the organizational responsibilities associated with maintenance history and trending analysis.

10.5.8 Maintenance Facilities and Equipment

Adequate maintenance facilities and equipment must be provided to ensure that maintenance activities can be safely, effectively, and efficiently performed. Facilities include shop, satellite work areas, lay–down and staging areas, and storage for equipment, tools, supplies, and parts. Design of maintenance facilities emphasizes:

- Industrial safety, including controlling environmental factors such as temperature, noise, fume removal, and lighting
- Radiological controls
- Human factors practices, including workstation layout and design, tool ergonomics, and equipment and materials handling

Personnel with maintenance experience have worked with the WTP design organizations to influence a final WTP Facility design that provides cost–effective maintenance facilities and equipment. Shops will be sized to support work associated with the largest anticipated repair activity, and to support multiple tasks. The shops will be equipped with all needed utilities, fixtures, and communications. They will include room for storage of a limited supply of parts, consumables and tools, and will be equipped with all anticipated material transportation systems.

During facility operations, maintenance management will periodically evaluate maintenance facilities, equipment, and tools to identify additions or improvements that would enhance performance.

10.5.9 Facility Condition Inspections

Good facility condition, cleanliness, and housekeeping as contribute to keeping systems and hardware in optimum condition to support safe and reliable operation. Facility personnel will be instructed in the importance of facility condition. Operations personnel will be trained to monitor facility conditions on their routine rounds, and will be expected to enter identified deficiencies in a tracking system.

A program of periodic facility inspections will be implemented to identify and disposition condition deficiencies that adversely degrade safety, reliability, and availability. 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. The effectiveness of management facility condition standards and the inspections program will be periodically assessed.

10.5.10 Management Involvement with Facilities Operations

The WTP Operations Contractor's corporate and facility management will maintain sufficient involvement with facility safety, the facility license, and facility operations to be technically informed and personally familiar with conditions at the WTP Facility. Management involvement will include in–person tours to monitor work in progress and the material condition of the facility. Management will also periodically review the maintenance program to verify that it is effectively accomplishing the intended objectives and is upgraded as needed.

To facilitate review of the maintenance program, management will establish and track performance indicators, goals, and objectives, and problem identification and corrective action processes.

10.5.11 Procurement of Parts, Materials, and Services

An effective parts, materials, and services program ensures the capability to maintain design requirements for maintenance activities during normal facility operations and to support planned and unplanned outages. The WTP QAM Policy Q–04.1, "Procurement Document Control," and Policy Q–07.1, "Control of Purchased Items and Services," describe the program for procurement to ensure that correct parts, materials, and services are available. The procurement program will also include measures to ensure timely procurement to support maintenance needs, specifically:

- Identifying long–lead–time items
- Ensuring adequate initial deliverable quantities and spare parts stocking levels
- Preventing the delivery or use of suspect/counterfeit parts
- Applying an upgrading process that defines means to qualify nonqualified parts and materials
- Applying a substitution process that facilitates use of replacements for parts that are no longer available or that have different material specifications
- Establishing a reorder system that ensures parts and material availability for anticipated usage, while minimizing unnecessary inventory
- Tracking procurement progress and taking appropriate actions to ensure that maintenance and outage schedules are met

10.5.12 Material Receipt, Inspection, Handling, Storage, Retrieval, and Issuance

Procedures will be implemented that specifically describe the process and responsibility for parts and material receiving, inspecting, handling, storing, retrieving, and issuing from stores. Some aspects of these procedures are discussed in the QAM, Policies Q–07.1–1, "Control of Purchased Items and Services," Q–08.1–1, "Identification and Control of Items," and Q–10.1–1, "Inspection." Additional process steps addressed in these procedures include:

- Establishing storage measures related to shelf–life, special environmental conditions, and other special handling and storage requirements
- Establishing storage locations that segregate non–safety related materials and parts to prevent inadvertent use of the wrong category item
- Establishing a periodic inspection of storage areas and re–issue rooms to verify that parts and materials are being stored and re–issued per requirements
- Establishing a parts and material tracking system that identifies current inventory levels and establishes automatic reorder/restocking criteria

- Establishing methods to control parts, materials, and equipment after issuance to ensure use in the correct application and to maintain traceability
- Establishing field storage conditions for consumables to ensure that they are properly stored, identified, and used

10.5.13 Control and Calibration of Measuring and Test Equipment

Properly calibrated measuring, tooling, and test equipment are essential to a comprehensive maintenance program. Calibration of measuring and test equipment is described in QAM, Policy Q–12.1–1, "Control of Measuring and Test Equipment." The WTP M&TE program will include the following elements:

- Identification numbering of all M&TE to provide traceability
- Procedures for calibrating M&TE and tagging the equipment to indicate calibration status
- Calibration of M&TE at a frequency that will maintain its accuracy and availability
- Procedures for storing and issuing M&TE
- Procedures for segregating and tagging M&TE with suspected or actual deficiencies
- Procedures governing timely evaluation of out–of–calibration or defective M&TE equipment
- Records for accountability and traceability
- Performance trending of M&TE calibrations to identify needed changes in the program or in M&TE devices
- Procedures governing costly evaluation of equipment tested with defective or suspected defective M&TE

10.5.14 Maintenance Tools and Equipment Control

The WTP project will implement a program for storing, issuing, and maintaining tools and equipment needed to accomplish maintenance activities effectively and efficiently. Craft personnel will have ready access to required tools and equipment.

The tool control program will include establishing a dedicated supply of tools and equipment for exclusive use within radiological controlled areas. Procedures will control the storage, issuance, decontamination, and reuse of contaminated tools and equipment.

10.6 References

Project Documents

24590–WTP–ISMP–ESH–01–001, *Integrated Safety Management Plan.*

24590–WTP–ISMSD–ESH–01–001, *WTP Project Integrated Safety Management System Description*, Preliminary.

24590–WTP–QAM–QA–01–001, *Quality Assurance Manual.*

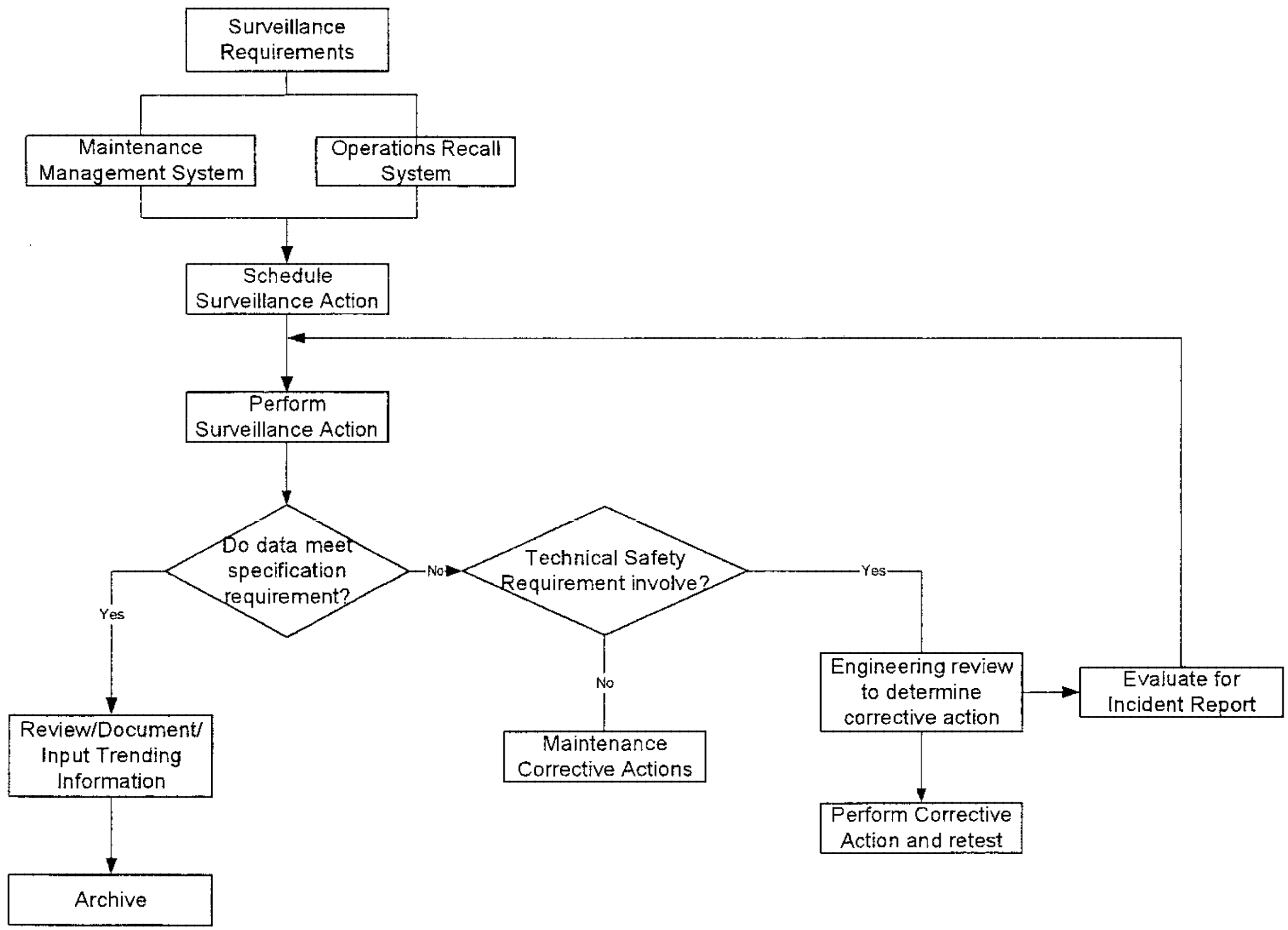
24590–WTP–SRD–ESH–01–001, *Safety Requirements Document.*

Codes and Standards

10 CFR 830. Subpart A, "Quality Assurance," *Code of Federal Regulations*.

ISA. 1996. *Application of Safety Instrumented Systems in the Process Industries*, ISA S84.01, The Instrumentation, Systems and Automation Society, Research Triangle Park, North Carolina.

Figure 10–1 Major Steps in the Surveillance Testing Process



11 Operational Safety

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11 Operational Safety

11.1 Introduction

In accordance to the Department of Energy (DOE) Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (DOE 1990), the River Protection Project - Waste Treatment Plant (WTP) will establish and maintain a conduct of operations program. This purpose of this program is to provide requirements and guidelines for developing directives and plans relating to the conduct of operations for the WTP facilities ensuring the safe and efficient operation of its facilities.

The conduct of operations program at the WTP will be one of the implementing programs for incorporating the Integrated Safety Management System core functions. It will address the guiding principles into the daily operating functions of each facility. The objective of this program will be to incorporate safety into management and work practices at all levels, addressing the types of work and the types of hazards to ensure safety for the workers, the public, and the environment.

The WTP Project conduct of operations program will be implemented at the WTP facility through a conduct of operations plan and a conduct of operations manual. A tailored approach will be used to ensure that the level of detail and the amount of resources expended are commensurate with each facility's potential impact on public and site personnel safety and health, and on the environment. This section summarizes the content of the draft conduct of operations plan.

The conduct of operations plan must be approved by the WTP Project and DOE prior to the start of commissioning as defined in WTP Contract No. DE-AC27-01RV14136.

The conduct of operations manual will contain the detailed guidance and requirements based on the WTP conduct of operations plan.

11.2 Requirements

Requirements for development and maintenance of the conduct of operations are described in these WTP Project Authorization Basis documents:

Safety Requirements Document

Section 7, Management and Operations; Safety Criteria 7.0-1 through 7.0-3

Section 7.5, Conduct of Operations; Safety Criteria 7.5-1 through 7.5-2

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 11
1.5	Operations	Section 11.3, "Conduct of Operations"

11.3 Conduct of Operations

11.3.1 Operations Organization and Administration

The conduct of operations manual will describe the organization and administration of facility operations ensuring that a high level of performance in operations is achieved through effective implementation and control of operations activities. It will include guidance for developing written operating standards, providing sufficient human and material resources, monitoring of operating performance, and improving facility performance.

11.3.2 Shift Routines and Operating Practices

Normal operations, including anticipated operational occurrences, maintenance, and testing will be controlled so that facility and system variables remain within their normal operating ranges and the frequency of demands placed on important to safety SSCs are minimized. The conduct of operations manual will specify the shift routines and operating practices that apply to facility operations and support personnel. It will provide standards for professional conduct, good watch standing practices, equipment monitoring, and management responsibilities that are fundamental to safe operation.

11.3.3 Control Area Activities

The conduct of operations manual will establish guidelines and requirements for performance of control area activities to ensure that the activities are conducted in a professional manner, operators are not overburdened by administrative duties, and distractions are minimized.

Prior to cold commissioning with hazardous chemicals, control areas will be defined for each applicable facility. The guidance and requirements for control area activities will be provided by the conduct of operations manual.

11.3.4 Communications

The conduct of operations manual will establish the methods for effective, reliable, and accurate transmission of information. It will provide guidance and requirements for communications within the facility, including guidance and requirements for both individuals sending communications and individuals receiving communications. Each of the areas addressed represents an avenue for contacting facility personnel and communicating information to personnel during normal, abnormal, and/or emergency conditions. The requirements will apply to facility operations and other applicable personnel.

11.3.5 Control of On-shift Training

The conduct of operations manual will specify requirements for control of on-shift training by facility personnel. On-shift training is the portion of a qualification requirement where the trainee receives training, within the work environment, with as much hands-on experience as possible.

The requirements will apply to operations personnel training and qualifications performed in the facility as part of the shift or normal work routine. The control of on-shift training requires that operation of equipment by trainees must be carefully supervised and controlled and that the trainees satisfactorily meet the training objectives and receive maximum benefit from the experience.

11.3.6 Investigation of Abnormal Events

The conduct of operations manual will establish a thorough review process that ensures significant aspects of an abnormal event are identified, investigated, and resolved. This review process interfaces with the occurrence reporting plan submitted to DOE in support of commissioning. Corrective actions will be developed to prevent recurrence of applicable causes. When required, a timely and comprehensive investigative report will be prepared and disseminated. Corrective action effectiveness will be determined by follow-up reviews and deficiency patterns.

11.3.7 Notifications

The conduct of operations manual will establish a notification process to provide timely notifications to appropriate company personnel, DOE personnel, and other agencies to ensure that the facility is responsive to public health and safety concerns. This notification process interfaces with the occurrence reporting plan submitted to DOE in support of hot commissioning and operations.

11.3.8 Control of Equipment and System Status

To satisfy design bases and operational limits, the proper component, equipment, and system configurations must be established and maintained. At the beginning of the commissioning phase, the conduct of operations manual will provide guidance for the following:

- Alignment of systems
- Locking of components
- Verification of technical safety requirements compliance for operating mode changes
- Authorization to remove or restore equipment to service,
- Documentation of equipment deficiencies, and use of facility status board(s).

The requirements will apply to facility operations and other applicable personnel responsible for administrative controls, procedures, and requirements that govern equipment and systems status. The manual applies to important to safety and associated essential support equipment and systems, and to other equipment and systems designated by facility management.

11.3.9 Lockouts and Tagouts

With the beginning of the commissioning phase of the project, the conduct of operations manual will provide guidance on the use of lockouts and tagouts for the purpose of hazardous energy control. This guidance will be implemented at the WTP Facility in accordance with requirements specified in a lockout and tagout procedure. Lockouts and tagouts for the purpose of hazardous material or technical safety requirement administrative controls will be performed in a similar manner.

A similar program has been implemented for the WTP construction phase to control situations where inadvertent energizing or startup of equipment or release of stored energy could cause injury to employees.

11.3.10 Independent Verification

The conduct of operations manual will provide uniform requirements for the WTP independent verification techniques. It will establish a high degree of reliability in ensuring correct facility operation and correct positioning of components such as valves, switches, and circuit breakers. The requirements apply to facility operations and other applicable personnel involved in the performance of independent verifications.

Independent verification will be performed in those cases where a reasonable potential exists for component mis-positioning or where the consequence of error is great. The application of the Manual will be dependent upon the safety and operations considerations of each process, system, or facility and will be documented in administrative and/or technical procedures.

11.3.11 Logkeeping

The conduct of operations manual will specify the requirements for establishing and maintaining operating logs for key operations positions in order to fully record the data necessary to provide an accurate history of facility conditions. An operating log is defined as a narrative sequence of events or functions performed by a specific shift position. Operating logs, which provide a system for ensuring that pertinent information is passed from one shift to the next, allow the history of a key position to be reviewed in event reconstruction, as well as support trending analysis.

Managers will identify operations and support positions that are defined as key positions requiring log keeping. Managers will provide guidance to operating personnel that defines the scope of information unique to each key position's shift operating log. The types of information that should be recorded in operating logs will be delineated in the conduct of operations manual.

11.3.12 Operations Turnover

The conduct of operations manual will define the site shift turnover process. This process ensures that relief personnel are provided with the knowledge required to accomplish their shift assignment responsibilities. The manual describes the controls necessary for conducting an orderly and accurate transfer of information regarding the overall status of the facility at shift turnover.

The shift turnover process applies to those facility operations that will be continued by an oncoming or relief shift without interruption of the operation, as well as major operational and maintenance activities that were completed during the previous shift.

11.3.13 Operational Aspects of Facility Chemistry and Unique Processes

Operational monitoring of process chemistry or unique data and parameters ensures that parameters are properly maintained. Monitoring parameters is important to verifying system operation in accordance with design expectations. In order to enhance proper process control of systems, operations personnel must have an understanding of WTP facility processes and must effectively coordinate operations activities with the WTP engineering department.

The conduct of operations manual will provide guidance and requirements for the involvement of operations personnel in facility chemistry and other unique processes.

11.3.14 Required Reading

The required reading program will be a method for ensuring that individuals are kept informed of important information that will enhance their ability to effectively perform their job assignment. The required reading program will be required for all operations personnel and other applicable personnel. The conduct of operations manual will provide the guidance and requirements for documentation, responsibilities, and the types of reading material that should be included in the required reading program.

11.3.15 Timely Orders to Operators

Shift orders will be issued to communicate short term information and administrative instructions to shift personnel. Information such as special operations, increased frequency in monitoring certain parameters, and so on, should be conveyed in shift orders. Standing orders will be issued to communicate long term information and administrative instructions to shift personnel.

The conduct of operations manual will provide the guidance and requirements for the approval, issuance, and maintenance of both standing and shift orders. Standing and shift orders are not to be used in lieu of approved operating procedures or as a way to circumvent necessary procedure changes.

11.3.16 Operations Procedures

The conduct of operations manual will establish methods and requirements for developing and writing, reviewing, approving, revising, canceling, and using technical and response procedures. These requirements apply to technical procedures, including system operating manuals, maintenance procedures, test procedures, surveillance procedures, and other procedures, which provide step-by-step instructions for the performance of an activity or evaluation and response procedures. Response procedures include Alarm Response procedures, abnormal operating procedures, and emergency operating procedures.

The procedures will maintain compliance with the Authorization Basis of the facility and will be based upon the same technical information that was used in establishing the Authorization Basis.

11.3.17 Operator Aid Postings

The operator aid posting program will describe the method for requesting, authorization, documentation, placing, reviewing, and removing required to ensure operator aids are current, complete, and necessary. Operator aids come in many forms, including copies of approved procedures, system drawings or simplified sketches, curves, graphs, quick reference cards, and so on.

The conduct of operations manual will describe the operator aid posting program.

11.3.18 Equipment and Piping Labeling

The equipment and piping labeling program will provide the general guidelines required to establish and maintain standardized and consistent labeling for permanent identification of plant equipment, valves, instruments, and piping.

The conduct of operations manual will provide details about this program - including: responsibilities, labeling requests, temporary label approval, and installation, label ordering, label installation, and program maintenance.

11.4 References

Project Documents

24590–WTP–ISMP–ESH–01–001, *Integrated Safety Management Plan.*

24590–WTP–SRD–ESH–01–001, *Safety Requirements Document.*

Codes and Standards

DOE. 1990. *Conduct of Operations Requirements for DOE Facilities*, DOE Order 5480.19, US Department of Energy, Washington DC.

13 Human Factors

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13 Human Factors

13.1 Introduction

Human factors engineering is a process that attempts to optimize total system performance, reliability, and safety by maximizing human performance, minimizing error, and assuring proper allocation of tasks to the human component in the system. Its goal is to ensure human safety and productivity and reduce the probability of human errors. The primary purpose for applying human factors engineering principles on the Waste Treatment Plant (WTP) is to reduce human error.

The manner in which human factors engineering principles are applied to the WTP is discussed below. The program complies with human factors requirements contained in the *Safety Requirements Document* (SRD) (24590-WTP-SRD-ESH-01-001-02), Volume II, specified below.

13.2 Requirements

Note: Approval of the following requirements is contingent upon approval of the ABCN to the *Safety Requirements Document* to address changes to the human factors requirements.

Safety Requirements Document,
Volume II; Safety Criteria 3.1-3, 4.3-4, 4.3-6, 4.3-7, and 9.1-2
Appendix B, 2.6

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 13
1.5	Human Factors	Section 13.3, "Human Factors Program"

13.3 Human Factors Program

In the design of the WTP Project, careful attention is paid to the interfaces between the operating personnel and the facility to ensure that good human factors and ergonomics practices are followed. This results in a facility that is user-friendly to minimize errors of omission and commission and to enable the operator to respond effectively to those situations in which human response is beneficial or required. Attention is given to the design and content of controls and displays (both hardware and software-generated) to ensure that clear and unambiguous indications of equipment status are readily available and understood without interpretation. Reviews of controls and displays ensure that compatibility with human psychology and physical characteristics is achieved and enable the required human tasks to be performed reliably and efficiently.

Proposed workstations and tasking, assessment of the physical components (e.g., dimensions, color coding, labeling, etc.) of the workplace, and the development of training for operators will be evaluated for human factors consideration. The goal is to eliminate or reduce the potential for human error. The human factors evaluation will incorporate a wide variety of nuclear and other process control and manufacturing facility experience. Human factors considerations, in conjunction with input of experienced operators and maintainers, identifies opportunities for design improvements and provides recommendations to project designers and engineers. Task analysis activities performed by project training will ensure the tools, equipment, and procedures are suitable for human use and reflect opportunity for the operators to perform their jobs and the associated elements error-free.

The design effort commences with the general layout of the facilities and continues through the detailed design stage. Human factors input to the project parallel the design efforts as they progress. Appropriate instruments and displays in the control rooms and at local control stations are particularly important to allow operators to detect and correct abnormal conditions. Alarm display systems, control screen layouts, and workspace design (including access, clearances, habitability, etc.) are also important to ensure that routine and special maintenance can be completed safely.

These human factors considerations support the basis for interactions and integration with other aspects of project design, including human factors support to engineering, training, the development of operating instructions and procedures, and any implications for safety management. The intent is to ensure that the training of operations personnel and other staff is compatible with the proposed facility operating regime and, that the operating procedures are developed to ensure full compatibility with the design of the tasks and the design of the equipment.

Implementation of the above-described human factors considerations are carried out via the guidance contained in the American National Standard IEEE Std 1023-1988.

13.4 References

Project Documents

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan.*

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document*, Volume II.

American National Standard IEEE Std 1023-1988, *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations*

15 Emergency Preparedness

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15 Emergency Preparedness

15.1 Introduction

This chapter describes the philosophy, objectives, and organization of the emergency management program (EMP) for response to emergencies at the River Protection Project - Waste Treatment Plant (WTP) facilities. It also discusses specific building emergency plans, relevant features of DOE/RL 94-02, *Hanford Emergency Management Plan,* for the WTP interface with Department of Energy (DOE), state, and local offsite organizations relative to emergency preparedness. The WTP EMP, in conjunction with DOE/RL 94-02, make up the EMP response plan for the WTP Project.

The WTP EMP applies to the WTP facilities, operations, and personnel. Response to events is performed using facility-specific and/or Hanford Site level emergency procedures to ensure that appropriate actions are taken to protect the health and safety of the workers, the public, and the environment.

15.2 Requirements

Safety Requirements Document

Chapter 7.8, "Emergency Preparedness"; Safety Criteria 7.8-1, 7.8-2, 7.8-3, 7.8-4

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 15
1.5	Emergency Planning	Chapter 15, "Emergency Preparedness"
1.5	Emergency Preparedness	Chapter 15, "Emergency Preparedness"

DOE/RL 94-02, *Hanford Emergency Management Plan*

15.3 Scope of Emergency Preparedness Program

The WTP hazard analysis (Chapter 3, General Information volume) and the facility hazard and vulnerability assessments for each hazardous facility provide the technical basis for the WTP EMP. Once the emergency program hazards assessment is performed, it will supercede the current hazard and vulnerability assessments. The extent of planning and preparedness corresponds to the type and scope of hazards identified for each facility and the potential accidents, fires, explosions, natural phenomena, and external events. Table 15-1 lists accident categories, accident types, consequences, and protective actions. Implementing details are provided in the WTP emergency management plan. Section 14.1 of DOE/RL 94-02 contains program administration requirements.

15.4 Emergency Preparedness Planning

Emergency preparedness planning includes WTP facility-specific emergency plans, procedures, emergency facilities, services, equipment, training, and the emergency response organization (ERO).

The WTP ERO incorporates the capabilities of the normal operating organization, augmented as needed to meet the functional requirements in the WTP EMP. Some ERO functions are performed by external organizations and by personnel who are not part of normal facility operations (medical support, security, and the Hanford Fire Department).

Interfaces with the WTP ERO, described in DOE/RL 94-02, include coordination of personnel protective actions, emergency notifications, activation of emergency centers, communications, consequence assessments, mitigation, event termination, and recovery.

15.4.1 Integrated Emergency Response Organization

This section describes the responsibilities of key individuals in the integrated WTP and site contractor ERO, and the chain-of-command for notifying, alerting, and mobilizing the necessary response personnel.

The Fluor Hanford, Inc. incident command interfaces with the WTP ERO, the Patrol staff, the Occurrence Notification Center (ONC), the Hanford Fire Department, and the Hanford Emergency Operations Center (HEOC). When an emergency is declared, the HEOC is activated to implement protective actions for site personnel; to recommend preplanned protective actions for offsite public; and to implement consequence assessment, event mitigation, and recovery actions. Responsibilities include technical, analytical, and emergency response support to contractor EROs conducting facility-level response actions. The Hanford Site emergency communication chain is shown in Figure 15-1.

The WTP ERO is responsible for emergency response at the event scene, protecting personnel, property, and the environment during an emergency.

15.4.1.1 WTP Emergency Response Organization

The WTP ERO is responsible for carrying out duties immediately, whenever an imminent or actual emergency exists, as required by *Washington Administrative Code* (WAC) 173-303. In accordance with DOE/RL 94-02, the building emergency director (BED) is responsible for initial and continuous direction of the ERO staff. Key WTP ERO positions and responsibilities are discussed in the following sections.

15.4.1.1.1 Building Emergency Director

Emergency response will be directed by the BED until the Incident Commander (IC) arrives. At this time, the BED becomes a member of the Incident Command Post (ICP) and functions under the direction of the IC. In this role, the BED continues to manage and direct WTP personnel performing response actions. Specific BED responsibilities are detailed in DOE/RL 94-02.

15.4.1.1.2 Incident Command Post Staff

The ICP staff consists of WTP personnel assigned and trained to support emergency response activities at the event scene. The ICP is managed by either the senior Hanford Fire Department member or the senior Hanford Patrol member present on the scene. These individuals are designated as the IC and as such, have authority to request and obtain the resources necessary for protecting people and the environment.

15.4.1.1.3 Event Scene Staff

The WTP event scene staff consists of ERO personnel with primary or alternate responsibilities. A BED, ICP hazards communicator, ICP communicator, and a hazards assessor (chemical, radiological, or both) will staff the event scene along with BED support personnel. The BED will also act as the plant operations specialist when meeting with non-WTP emergency support personnel (Hanford Fire Department, Hanford Patrol, and so on).

15.4.1.2 Hanford Emergency Operations Center

The HEOC is made up of several organizations responsible for implementing defined emergency response tasks. These organizational areas are defined in the following subsections. Detailed procedures for activation, staffing, and operation of the HEOC are in DOE 0223, *Emergency Plan Implementing Procedures.*

15.4.1.2.1 Richland Operations Office/Office of River Protection Emergency Policy Team

The primary responsibilities of the Emergency Policy Team are the oversight of onsite activities, approval and communication of recommendations for offsite protective actions, approval of reclassification recommendations, oversight of public information activities, and coordination with offsite agencies.

The policy team is staffed by the Richland Operations Office/Office of River Protection (RL-ORP) emergency manager, public information director, emergency preparedness advisor, offsite interface coordinator, DOE-headquarters (HQ) liaison, and the responding state and county representatives.

During security incidents, RL is responsible for decisions that address mitigation of the security event. This involves direction and control of the Hanford Site security and patrol forces, and coordination of facility response. However, the Federal Bureau of Investigation may exercise its option to take command of security events involving a violation of the *Atomic Energy Act of 1954* (AEA 1954) or other federal statutes. Associated response by Site contractor personnel for personnel and operational safety rests with the IC and the BED.

15.4.1.2.2 Policy Team Staffing and Responsibilities

The RL manager (or designee) will be the RL-ORP emergency manager, except when the event involves an ORP facility, in which case the ORP manager (or designee) will assume the responsibility. The RL-ORP emergency manager is responsible for oversight operations of the HEOC and for ensuring implementation of RL responsibilities. In consultation with the HEOC staff, the RL-ORP emergency manager approves emergency reclassification and termination, offsite protective action recommendations, and notifications.

General responsibilities of the policy team include:

- Overview of onsite response and mitigation actions, and providing event assistance to support the WTP, as needed
- Providing offsite notifications and protective action recommendations to state, local, and federal agencies, and continuous updates to the state and counties about conditions

- Notifying the DOE-HQ cognizant secretarial officer and the DOE-HQ emergency management team if facility operations were shut down as a part of the protective action response
- Providing direction and control, as appropriate, during a security incident
- Reclassifying or terminating the emergency
- Directing the activities of the Joint Information Center (JIC) in providing timely and accurate release of information to the public and media, including approval of RL-ORP news releases
- Forwarding requests for additional DOE emergency response assets to the regional response coordinator as needed
- Providing liaisons to offsite emergency centers and corresponding DOE emergency response assets
- Providing a representative to DOE-HQ as requested
- Designating a recovery organization

15.4.1.3 Joint Information Center

The JIC's primary responsibility is to disseminate of accurate, timely information to the public and employees about RL-ORP activities during declared emergencies. The JIC is staffed by RL-ORP, contractor, state, and county communication professionals responsible for coordinating the release of information to the public and the media.

One or more newswriters work next to the policy team area to obtain current information for drafting press releases. Once the press release is developed, the newswriter(s) ensures that each one is reviewed for technical accuracy and security sensitivities before approval by the RL public information director. Upon approval, the press releases are sent to the JIC for dissemination.

The JIC provides a single location where RL-ORP and site contractors can coordinate the release of information with other federal agencies and state and local jurisdictions. The JIC operates under the direction of the RL public information director and is managed and staffed by RL-ORP and site contractor personnel. Provisions shall be made at the JIC for representatives from the states of Washington and Oregon, emergency planning zone counties, and other federal agencies that may be involved in the emergency response.

The JIC's functions include the following:

- Preparing and coordinating information released to the public and media
- Answering questions of the public and media
- Rumor control

15.4.1.4 Site Management Team

The Site Management Team (SMT) supports the IC organization by providing additional resources not easily obtained by the organization. This support includes tracking the status of onsite protective actions, developing and directing implementation of additional onsite protective actions away from the event scene (that is, the area not under the direct control of the IC organization), and providing communications support. The SMT is also responsible for hazard assessment activities, tracking personnel medical issues, developing additional offsite protective action recommendations, recordkeeping, and overall operation of the center.

The SMT is made up of four support organizations responsible for implementing defined emergency response tasks: (1) executive team and support staff, (2) security and event support, (3) unified dose assessment center, and (4) DOE HEOC. These organizations are defined below, and shown in Figure 1.

15.4.1.4.1 Executive Team and Support Staff

The Site Emergency Director (SED) is responsible for coordinating all SMT activities. In this role, the SED is responsible for the activities of the event support coordinator, HEOC operations manager, and the consequence assessment director.

Because RL has an operational function over Hanford security forces, the security director is responsible for the activities of the security operations coordinator. The security director will receive information from and provide direction to the security forces. The security director will communicate planned actions of security forces to the SED and safety oversight director to ensure that all safety and security issues are addressed and coordinated. The SED, in conjunction with the security director and safety oversight director, is responsible for periodically providing status information to the RL-ORP emergency manager and the policy team. The contractor representative and SMT emergency preparedness advisor support the SED.

15.4.1.4.2 Security and Event Support

As part of the SMT staff, the security operations coordinator's primary functions are security operations, which include interface with local law enforcement agencies, coordination with the Federal Bureau of Investigation, and oversight of onsite patrol activities. The security operation coordinator reports directly to the security director.

The event support coordinator is responsible for event support activities, including site support services, technical support, communications with the event scene, and coordination with the emergency decontamination facility and other medical assessment activities. The event support coordinator reports directly to the SED.

15.4.1.4.3 Unified Dose Assessment Center

As part of the SMT, the primary Unified Dose Assessment Center (UDAC) functions are to monitor and evaluate existing emergency conditions in order to develop additional protective action recommendations. The UDAC is responsible for field team activities, including plume tracking, monitoring, and sampling.

Washington and Oregon State representatives participate in developing recommendations and provide direction for offsite environmental monitoring. The UDAC is operated by site contractor personnel with knowledge in the technical areas of meteorology, toxicology, industrial hygiene, and health physics. The consequence assessment director is responsible for all UDAC activities, and reports directly to the SED.

Specific UDAC responsibilities include:

- Acquiring necessary data and measurements to evaluate personnel radiation doses and chemical exposures resulting from the event

- Assessing the potential for onsite and offsite consequences of a release of radioactive or nonradioactive materials based on meteorological conditions, source term, location and dispersal of the hazardous material
- Assisting the event contractor or other Hanford Site contractors in onsite hazard assessment or development of onsite protective actions
- Analyzing the consequences associated with evacuating versus remaining in a take-cover situation for onsite personnel, and recommending appropriate additional protective actions as necessary
- Developing offsite protective action recommendations in coordination with representatives from the states of Washington and Oregon
- Coordinating and directing emergency environmental monitoring teams not assigned to the event facility, including state field teams performing offsite monitoring as requested by the states

15.4.1.4.4 DOE HEOC Operations

As part of the SMT, the primary functions of the DOE HEOC operations team are administration, recordkeeping tasks, and dissemination of information to offsite agencies (Hanford Emergency Notification Form, UDAC products, and so on). The HEOC operations manager is responsible for these activities. In this role, the HEOC operations manager reports directly to the SED.

15.4.2 Assessment Actions

Emergency events require initial, prompt, and continuous response actions. DOE/RL 94-02 identifies Categorization and Classification of Operational Emergencies and Consequence Assessments as two processes critical to protecting workers, the public, and the environment. Appropriate notifications and response actions are also promptly initiated during a declared emergency. The following sections discuss the processes that recognize and categorize serious events or conditions and timely assessments necessary to support informed decisions to protect people.

15.4.2.1 Categorization and Classification

Events are categorized and classified to ensure that appropriate notifications and response actions are promptly initiated. An event will be categorized within 2 hours after the event is identified. The WTP can conservatively categorize an event at the highest level (if categorization is not clear) and elevate, maintain, or lower the event categorization as further information is obtained. The actions triggered by categorization range from management activities (such as regulatory reporting) not required to be initialized until after an event is closed out, to full activation of onsite and offsite emergency response organizations.

Two categories of WTP events are used to meet the requirements of federal and state regulations, and mutual agreements between DOE and state and county agencies:

- Operational Emergencies represent specific threats to WTP personnel, Hanford Site workers, and the public, due to the release or potential release of significant quantities of radiological and non-radiological hazardous materials. Operational Emergencies are further classified as Alert, Site Area Emergency, and General Emergency. Table 15-2 summarizes the severity of each and the general area of possible impact. Detailed descriptions of each class are in DOE 94-02 and the emergency management plan.

- Abnormal Events include any spills, releases, fires, and explosions that require implementing the *Resource Conservation and Recovery Act of 1976* contingency plan in accordance with WAC 173-303, but do not reach the level of an Operational Emergency. Specific guidelines for determining if an event has met the contingency plan are in DOE 94-02 and the emergency management plan.

The BED makes the initial event classification, based on an evaluation and assessment. The BED, in consultation with the Environmental Point-of-Contact (EPOC), determines whether the situation constitutes an Abnormal Event. The BED is responsible for making this determination, even though in consultation with the EPOC. Detailed responsibilities are in the implementing procedures.

15.4.2.2 Emergency Action Level

Emergency action levels (EALs) are specific, predetermined trigger points used to detect, recognize, and classify emergencies identified by the emergency preparedness hazards assessment. EALs are typically identified as either event-based or symptom-based. The distinction arises from the available methods of detecting and recognizing the initiating conditions of the event. The development of symptom-based EALs is preferred, recognizing that there will usually be some initiating conditions that require an event-based approach. Initiating conditions must be identified specifically in EAL procedures and must be observable and recognizable in a timely manner by responsible personnel.

The WTP facility-specific EALs will be developed for the potential emergencies identified by the emergency preparedness hazards assessment. The definitions in Table 15-2, in conjunction with Table 15-3, set forth the criteria to classify emergencies. The WTP BED initially classifies emergency events in accordance with EAL tables in emergency plan implementing procedures. Notification and participation of offsite organizations, and determination of what and when protective actions will be implemented, are also based on event classification using EALs.

15.4.2.3 Hazards Surveys and Hazards Assessments

Emergency management efforts begin with the identification of hazards (see General Information volume, Chapter 3). The scope and extent of emergency planning and preparedness must be commensurate with the hazards. The hazards survey summarizes the potential impacts of emergency events or conditions and the applicable planning and preparedness requirements. Hazards assessments include the identification and characterization of hazardous materials (radiological or non-radiological) specific to a facility or activity, analyses of potential accidents or events, and evaluation of potential consequences.

A hazards survey (qualitative examination) will be prepared to identify the conditions to be addressed by the WTP EMP. Each hazards survey will be updated as necessary. The hazards survey will:

- Identify and describe the facility or activity
- Identify (for example, in matrix or tabular form) the emergency conditions (fires, work place accidents, natural phenomena, and so on)
- Describe the potential health, safety, or environmental impacts related to specific and surrounding facilities
- Summarize the planning and preparedness requirements that apply

A hazards assessment will be conducted to determine if an event could result in the declaration of an Operational Emergency as described in DOE 94-02. If the analysis results indicate the potential for an Alert, Site Area Emergency, or General Emergency, the results of the analysis will be used to determine the necessary personnel, resources, and equipment for the emergency response. If the hazards assessment indicates that all events would be classified as less than an Alert, the minimum program requirements will encompass the requirements for "Hazardous Waste Operations and Emergency Response" in 29 CFR 1910.120.

The WTP will develop criteria for assessing the possible hazards to human health and the environment. Hazardous materials are any solid, liquid, or gaseous materials that are toxic, flammable, radioactive, corrosive, chemically reactive or unstable upon prolonged storage in quantities that could pose a threat to life, property, or the environment.

The hazards assessments will include a determination of the size of the emergency planning zone. The emergency planning zone is the area surrounding the WTP where special planning and preparedness actions are taken, or need to be taken, to reduce or minimize the impact to WTP personnel, Hanford Site workers, and public health and safety in the event of an Operational Emergency.

15.4.3 Notifications

Notifications are made for events at the WTP according to the event category (Operational Emergency or Abnormal Event). Notifications for an Operational Emergency supercede Abnormal Event notifications. Thus, when an event is classified as an Operational Emergency that also meets the criteria for an Abnormal Event, no additional initial notifications for an Abnormal Event are necessary.

The emergency notification flow diagram outlines how the WTP implements the required notifications for Operational Emergencies and Abnormal Events. Responsible personnel will make notifications for abnormal and emergency events in accordance with the emergency notification flow diagram and emergency plan implementing procedures. The DOE will be informed verbally in all cases within 15 minutes, upon discovery of an emergency event.

15.4.3.1 Operational Emergency Notifications

Prompt and accurate emergency notifications are essential to mitigate event consequences and protect the health and safety of workers and the public. For Operational Emergencies, emergency plan implementing procedures will be established to promptly notify workers and emergency response personnel and organizations, including appropriate offsite and onsite agencies, under the most limiting set of conditions.

Notifications will be made in accordance with DOE requirements to

- Augment the Hanford Site and WTP operating staff with personnel in designated roles to respond to the emergency
- Activate emergency centers
- Facilitate public notification by offsite authorities and agencies with decision-making authority for directing protective actions
- Protect Hanford Site and WTP personnel and emergency workers by providing information necessary to implement accountability and protective actions (such as take cover, sheltering in predetermined locations, and evacuation)

15.4.3.1.1 Initial Onsite and Offsite Notifications

The BED will make the initial event classification (Alert, Site Area Emergency, or General Emergency), in accordance with WTP EALs tables in the emergency plan implementing procedures.

The BED will initiate immediate notifications to implement the following protective actions:

- Request emergency response assistance by the 911 emergency number
- Notify Hanford Site personnel by sirens and the Hanford Site crash alarm telephone system
- Notify WTP personnel by the plant alarm systems, cellular telephones, plant telephones, radios, intercoms, and runners

Additionally, the BED will communicate event information to the ONC and ensure that the ONC receives a completed copy of the Emergency Notification Form, in accordance with the emergency plan implementing procedures. The ONC is then responsible for completing and transmitting the emergency notification to predetermined offsite agencies, as described in DOE/RL 94-02.

15.4.3.1.2 Reclassification Notifications

The BED will make notifications of reclassification of rapidly escalating emergencies until the HEOC is declared operational, using the procedures outlined in section 15.4.3, above. When the HEOC is declared operational, the HEOC will be responsible for making reclassification notifications, as described in DOE/RL 94-02.

15.4.3.1.3 Emergency Termination Notifications

When an emergency is declared terminated, the ONC will notify the agencies initially notified of an emergency, as directed by the HEOC, as described in DOE/RL 94-02.

15.4.3.2 Abnormal Event Notifications

Events or situations may occur at the WTP that, while not creating or indicating emergency conditions, may generate public concern or media interest. Local, state, and tribal entities need timely information on these events to reassure the public that these situations do not threaten their health or safety.

The WTP BED will notify offsite entities of Abnormal Events using the Hanford notification process. The WTP facility will promptly report events that meet the Abnormal Event criteria to the ONC. The ONC will then notify agencies as described in DOE/RL 94-02.

Environmental notifications delineated below are for those events that do not meet Operational Emergency criteria but that require notifications.

15.4.3.3 Environmental Notifications

Numerous environmental notifications must be made, including those for emergency plan implementation (spill, release, fire, or explosion), or events that exceed an environmental permit. These notifications will be made verbally and in writing, depending on the event type. In many cases, notification requirements are based on quantity and location of a spill or release.

The WTP will develop and maintain procedures to ensure that environmental notifications are made in accordance with federal, state, or local requirements and agreements. Although events relating to spills or releases usually do not meet criteria for a declared emergency, environmental notifications will be conducted. For environmental events that meet Abnormal Event criteria, notifications will follow section 15.4.3.2.

15.4.3.3.1 Initial/Verbal Notifications

For any event that involves a spill, release, fire, or explosion, or exceeds an environmental permit, the BED will notify the EPOC to determine applicability of requirements, and to perform appropriate environmental notifications. The EPOC will notify the appropriate federal, state, and/or local agencies.

15.4.3.3.2 Written Reports

The WTP will develop necessary written reports and submit them to the DOE for review and concurrence, in accordance with WTP environmental reporting procedures, before submitting them to the Washington State Department of Ecology (Ecology).

15.4.3.3.3 Resumption of Operations

The WTP will notify Ecology and local agencies, as applicable, that the WTP is in compliance with cleanup activities, before operations are resumed following the implementation of the contingency plan, in accordance with WAC 173-303.

15.4.4 Emergency Facilities and Equipment

Facilities and equipment as outlined below will be provided adequate to support emergency response, including the capability to notify employees of an emergency to facilitate the safe evacuation of employees from the work place, immediate work area, or both.

15.4.4.1 Emergency Facilities

This section describes the WTP and Hanford Site facilities equipped for emergency control, operations, and coordination.

15.4.4.1.1 Hanford Emergency Operations Center

The HEOC is described in DOE/RL 94-02.

15.4.4.1.2 Hanford Patrol Operations Center

The patrol operations center is maintained as described in DOE/RL 94-02.

15.4.4.1.3 Occurrence Notification Center

The ONC is maintained as described in DOE/RL 94-02.

15.4.4.1.4 Emergency Medical Facilities

Capabilities for medical aid, triage, and personnel decontamination will be available at the WTP or through the Hanford Fire Department. The following section describes emergency medical support.

15.4.4.1.4.1 WTP Emergency Medical Facilities

Emergency medical facilities at the WTP will include the following:

- WTP Health Care Center: The Health Care Center will contain sufficient medical supplies to treat patients with occupational illnesses or injuries who do not require hospitalization. An ambulance service will be provided by the Hanford Fire Department.
- WTP Personnel decontamination facilities.
- Emergency Decontamination Facility: The Emergency Decontamination Facility is north of Kadlec Medical Center in Richland, Washington. This is a dedicated, hardened facility designed to accommodate non-serious or non-life-threatening radiologically contaminated injuries.

15.4.4.1.4.2 Offsite Emergency Medical Facilities

DOE and local hospitals have agreements in place for backup medical treatment (see DOE/RL 94-02, Appendix B). Through agreements with DOE, the WTP will use the existing Memoranda of Understanding.

15.4.4.1.5 State and County Emergency Operations Centers

- Benton County Emergency Operations Center (EOC) – 651 Truman Avenue, Richland, Washington
- Franklin County EOC – 502 Boeing Street, Pasco, Washington
- Grant County EOC – 6500 32nd Avenue NE, Moses Lake, Washington
- Washington State EOC – Washington State Emergency Management Division office (Building 20), Camp Murray, Tacoma, Washington
- Oregon State EOC – Oregon Emergency Management Division office, 595 Cottage Street NE, Salem, Oregon

15.4.4.1.6 WTP Emergency Facilities

The WTP will have a dedicated ICP adjacent to the main control room in the pretreatment plant. An alternate ICP will be determined at a later date.

15.4.4.2 Emergency Equipment

An emergency equipment list will be developed and maintained in an emergency plan implementing procedure. Equipment intended for emergency response will be listed, capabilities described, and location(s) identified. Emergency equipment at the WTP may include fire extinguishing systems, spill control equipment, monitoring equipment, communications equipment (including alarms), and decontamination equipment. Emergency equipment that may be used at the WTP is described below.

15.4.4.2.1 Fire Control Equipment

The WTP will be equipped with fire control equipment such as automatic fire-suppression systems and portable fire extinguishers, as appropriate, in accordance with National Fire Protection Association safety codes. Portable fire extinguishers will comply with National Fire Code standards. WTP facilities that contain hazardous materials will have emergency wash equipment (safety showers and eye wash stations). Protective storage areas will have portable eye wash equipment as necessary.

15.4.4.2.2 Assessment Equipment

Emergency equipment will be available, as appropriate, to allow early and reliable determination of the seriousness of an event or emergency. Equipment for both emergency and continuing assessment of the buildings and environment will be provided, such as dosimeters, radiological instrumentation, and effluent and environmental monitoring equipment. Arrangements for aerial surveillance and monitoring through the UDAC are in place with the Aerial Measuring System (DOE Nevada Operations Office) through DOE as described in DOE/RL 94-02.

15.4.4.2.3 Emergency Instrumentation

The instrument and equipment pool for normal operations at both the WTP and Hanford Site facilities will provide many supplies and equipment for emergencies. This pooling of resources will ensure that multiple sources of supplies are available.

15.4.4.2.4 Spill Control and Contamination Supplies

Spill control and contamination supplies will be located at WTP facilities and areas as necessary. Supplies may include sorbent materials for organic or inorganic materials; diatomaceous earth for liquid waste spills; neutralizing sorbents for response to acid or caustic spills; containers and salvage containers; and brooms, shovels, and miscellaneous spill response supplies.

15.4.4.2.5 Emergency Protective Equipment

The WTP will have protective clothing and respiratory protective equipment, as applicable, for routine and emergency use.

15.4.4.3 Hanford Patrol

Hanford Patrol maintains security equipment, including transportation, weaponry, protective equipment, and communication.

15.4.4.4 Hanford Fire Department

The Hanford Fire Department maintains firefighting, hazardous material response, and rescue equipment, and operates the site ambulance service from area fire stations.

15.4.4.5 Maintenance and Testing of Alarm and Communication Systems

The WTP maintenance organizations are responsible for scheduling and performing maintenance on facility sirens, alarms, and other emergency communication equipment. Sirens and alarms will be tested in cooperation with the Hanford Site testing schedule. The WTP will establish emergency plan implementing procedures for the maintenance and testing program.

15.4.5 Protective Actions

Protective actions are those actions taken to preclude or reduce the exposure of individuals to hazardous materials waste following an accidental release. Initial protective actions for such an accident or release will be predetermined for WTP personnel, Hanford Site employees, and the public and will include:

- Methods for controlling, monitoring, and maintaining records of personnel exposures to hazardous materials or dangerous waste
- Plans and procedures for timely sheltering and evacuation of workers
- Methods for controlling access to contaminated areas and for decontaminating personnel or equipment
- Steps to increase the effectiveness of protective actions (for example, heating, ventilation, and air conditioning shutdown)
- Methods for providing timely protective action recommendations (such as sheltering, evacuation, relocation, and food control) to appropriate offsite agencies
- Protective action guides (PAGs) and emergency response planning guidelines (ERPGs), prepared in accordance with approved guidance applicable to the actual or potential release of hazardous materials or dangerous waste to the environment, for use in protective action decision making
- Protective actions will be evaluated during the event and modified as necessary, by the BED or IC for the event scene area, and by the HEOC for Hanford Site modifications

15.4.5.1 Protective Action Guides

PAGs are used to determine the appropriate protective action recommendations. The WTP will use the PAGs adopted by the states of Washington and Oregon, which are based on the PAGs in EPA 400-R-92-001, *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (EPA 1991). These PAGs apply to projected doses of exposures from airborne releases of radioactive materials and subsequent depositions during the early, intermediate, and late phases of an accident. Pathways considered include external gamma and beta dose from direct exposure to airborne materials and from deposited material, as well as the committed dose to internal organs from inhalation of radioactive material.

The projected dose values for initiating protective actions specified by the states of Washington and Oregon is 1 rem total effective dose equivalent, where the projected dose represents the sum of effective dose equivalent resulting from exposure to external sources and the committed effective dose equivalent from all significant inhalation pathways during the early phase. The PAG values for committed dose equivalent to the thyroid and the skin are 5 and 50 times larger, respectively.

The PAG acronym is interpreted to mean where the total effective dose equivalent of 1 rem to standard man is the sum of the effective dose equivalent from exposure to external sources and the committed 50-year effective dose equivalent from inhalation during the early phase.

15.4.5.2 ERPGs for Nonradiological Releases

The WTP will use the ERPGs for nonradiological releases as described in DOE/RL 94-02. In the ERPG system, the three values are defined for each material as:

- ERPG - 1: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor
- ERPG - 2: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective actions
- ERPG - 3: The maximum airborne concentration, below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects

15.4.5.3 WTP Protective Actions

The WTP emergency plan implementing procedures will provide for immediate actions to be taken to prevent or reduce exposures. These procedures, implemented by the BED and other trained responders, will contain the provisions in DOE/RL 94-02.

15.4.5.3.1 Essential Personnel

Essential personnel who perform safety shutdown duties before taking protective actions may respond differently than other personnel. The BED will be responsible for the safety of identified essential personnel during these activities.

15.4.5.3.2 Personnel Accountability

The WTP will provide for a personnel accountability system commensurate with the hazards associated with the processes. This system will be implemented in accordance with emergency plan implementing procedures. Personnel will be accounted for immediately after emergency protective actions have been implemented.

15.4.5.3.3 Access Control

Access to affected areas will be controlled in an emergency. The emergency plan implementing procedures will address the need to allow emergency personnel access to controlled areas as necessary, logging entries, providing dose assessments, and maintaining exposure records for WTP emergency workers.

15.4.5.3.4 WTP Facility Take Cover

The WTP emergency plan implementing procedures are maintained to implement protective actions. "Take cover in place" will be implemented when hazards and the movement of personnel may pose a risk. The WTP BED is responsible for implementing a take cover, either when notified via crash telephone or when WTP specific implementing procedures require immediate actions.

Personnel will be sheltered in predesignated shelters, if time allows for safe travel to these locations. Sheltering personnel in predetermined locations will allow personnel to be accounted for early in an event. The BED will implement sheltering in accordance with emergency plan implementing procedures.

15.4.5.3.5 Hanford Site Take Cover

Upon notification by the WTP, the Hanford Patrol and the HEOC will consider an area or site take-cover alarm, as described in DOE/RL 94-02.

15.4.5.3.6 WTP Facility Evacuation

An evacuation at the WTP due to either a Hanford Site event or a WTP event requires personnel in specific buildings or areas to evacuate. The BED is responsible for implementing an evacuation in such an emergency. The following steps would be followed for evacuating the WTP:

- Evacuation due to a Hanford Site emergency will be implemented upon notification over the crash alarm telephone. In most cases, the facility would have been in a take-cover or shelter condition and personnel accountability completed. If so, then personnel will be given the evacuation routes, secondary staging locations, and released. If personnel accountability had not been completed, personnel will assemble in staging areas until all sweeps and accountability are completed. Evacuation routes and secondary staging locations will be provided and personnel released.
- For an event at the WTP, personnel may be evacuated from a specific building to either a sheltering location or the staging area for accountability. If further evacuation is necessary, the step described above will be followed.

15.4.5.3.7 Emergency Medical Support

The WTP will ensure that provisions exist for emergency medical aid, triage, and decontamination, and planning for mass casualty situations. Because of the potential for injuries accompanied by radiological contamination, medical support will include documented arrangements with offsite medical facilities to accept and treat contaminated, injured personnel, for emergency medical services not provided on the Hanford Site. DOE has arrangements with offsite medical service providers, for emergencies occurring at the Hanford Site. The WTP will participate in existing Memoranda of Understanding.

Medical support is planned in advance for workers contaminated by hazardous material. Hanford Site organizations are authorized by DOE to provide the medical response to onsite emergencies. Specific procedures related to organizations involved in site emergencies are in documentation maintained by the respective organization.

15.4.5.3.8 Termination of Protective Actions

The relaxing or lifting of protective actions at the WTP generally will be based on the facility conditions and consequence assessments. The HEOC will decide when Hanford Site protective actions can be terminated. For an emergency at the WTP, the IC, in consultation with the BED, will decide to terminate protective actions. The HEOC will provide recommendations to affected counties and states for relaxation of offsite emergency protective actions. The states will be responsible for decisions on relaxation of ingestion protective actions, based on data provided by the UDAC.

15.4.6 Training, Exercises, and Drills

In addition to training that WTP personnel receive for day-to-day functions, the WTP EMP will a coordinate training, exercises, and drills for developing and maintaining specific emergency response capabilities.

The WTP will use the Hanford Site's existing programs (where possible), and training, exercises, and drills based on information from the hazards surveys and hazards assessments Training, exercises, and drills will be specified in emergency plan implementing procedures.

15.4.6.1 Training Requirements

Formal job descriptions and qualifications will be established for the BED and emergency response staff. At a minimum, these criteria address education, related experience, familiarity with WTP procedures, and satisfactory performance in the position during an exercise or drill. The BED and alternates will attend a training course specific to BED roles and responsibilities. The WTP training program's control and administrative processes ensure that each member of the emergency response staff meets qualifications, experience, and training requirements. The adequacy of the BED, the emergency response staff, emergency plan implementing procedures, and functional capabilities will be evaluated during emergency exercises and drills.

Emergency-related information, transportation information, and training on the WTP-specific conditions and hazards will be made available to offsite personnel who may be required to respond to an emergency at the WTP. The training will be provided in support of and in conjunction with the DOE, counties, states, and tribes at their request. Information on hazards and emergency response procedures also will be provided to the media and the public as appropriate.

15.4.6.2 Exercise Program

Exercises enable WTP personnel to respond to a simulated emergency, and demonstrate and validate general training and WTP facility-specific training.

The WTP will establish and maintain a formal exercise program to validate all elements of the EMP. The exercise program will be documented in an emergency plan implementing procedure. Each exercise will have specific objectives and will be documented.

Exercises will be evaluated by a critiquing process that includes gathering and documenting observations of the participants. Corrective action items identified as a result of this process will be incorporated into the WTP EMP tracking system. The EMP administrator will be responsible for maintaining the tracking system, to ensure that all actions are tracked to closure.

The WTP emergency management exercise program will include

- Scheduling
- Development
- Quality control
- Critiquing
- Reports

- Coordination with the Hanford Site exercise program
- Action tracking

Exercises will be part of the annual WTP work plan to ensure that responders are prepared. WTP staff assigned duties in the HEOC will participate in exercises annually, as designated in the exercise schedule. The exercises will be designed to test and demonstrate the Site's integrated emergency response capabilities. Emergency management exercises will adhere to operational emergency notification and reporting requirements.

The WTP will maintain an exercise program with two types of exercises:

1 Limited Exercise - A limited exercise may separately test and validate the responsibilities of the IC organization, staff members responding to the HEOC, portions of each together, or all in coordination with Hanford Site response organizations.
2 Field Exercise - A field exercise will test and validate the responsibilities of all aspects of the WTP emergency program, facility personnel, and its coordination with the HEOC. Additional offsite involvement may be included.

15.4.6.3 Drill Program

Drills will provide supervised hands-on training and application sessions for WTP emergency response staff, to demonstrate and maintain individual and organizational proficiency. To ensure response proficiency, drills will be assessed to identify and document the training needs and areas of less than adequate performance.

Emergency preparedness drills at the WTP will include all elements of the emergency preparedness program. A given drill may include only those specific elements that pertain to the scope of that drill. Operations drills are not considered part of the EMP, but may include elements of emergency response.

An emergency preparedness drill will involve designated facility emergency response personnel and the Hanford IC system. The type of drill to be conducted will be clearly communicated to all participants, observers, controllers, and evaluators. They could include tabletop drills, walk-through training drills, and full facility participation drills.

Emergency preparedness drills will require the use of the appropriate emergency plan implementing procedures and, at a minimum, will demonstrate the following:

- Implementation and coordination of facility protective actions such as take cover or evacuation
- Event recognition and classification
- Event mitigation
- Emergency and environmental notifications and communications
- Interface with IC system functions and other affected Hanford resources

A protective action drill will involve all WTP personnel, and may be conducted separately or included in emergency preparedness or operations drills. Personnel accountability will be performed, when appropriate, during protective action drills.

For emergency preparedness and protective action drills, each drill objective will have evaluation criteria. A participant critique will be conducted immediately after the drill to provide preliminary feedback on objectives and to allow participants to self-assess. In a separate controller critique, the controllers will evaluate each objective and the overall drill. The drill coordinator will be responsible for the drill and will receive the report from the lead controller.

15.4.7 Emergency Termination, Reentry, and Recovery

Predetermined criteria for termination of emergencies will be developed and maintained in WTP emergency plan implementing procedures, and will be consistent with the Hanford Site emergency procedures. Reentry and recovery will include notifications associated with termination of an emergency and establishment of criteria for resumption of normal operations.

Initial reentry will be conducted under the IC system. Reentry may be necessary throughout the event and for both termination and recovery planning purposes.

15.4.7.1 Termination of the Emergency

Response activities are terminated when the event has been stabilized, that is, it meets these conditions:

- Potential threats to WTP and Hanford Site workers, the public, and the environment have been stabilized,
- Conditions no longer meet established emergency categorization criteria, and
- It appears unlikely that conditions will deteriorate.

Once the emergency has been declared terminated, activities can focus on recovery.

An emergency will be declared terminated after applicable criteria in emergency plan implementing procedures have been met and concurrence between the WTP and the HEOC has been obtained. The BED, IC, and HEOC staff must confer and agree that termination can be declared.

As described in DOE/RL 94-02, the HEOC emergency manager will coordinate the termination recommendation with state and county representatives and make the official emergency termination declaration. Termination of the emergency will then proceed in accordance with DOE/RL 94-02.

15.4.7.2 Reentry

Reentry is the act of reentering an evacuated area or building to perform emergency activities, assess facility damage to determine if the emergency can be terminated, and determine the extent of required recovery activities and life saving responses.

Reentry can be performed at any time before termination of the emergency and during recovery activities. For reentry before the event is terminated, the BED and IC must determine appropriate protective measures for personnel reentering the event building or area and authorize reentry.

The WTP BED and the HEOC will assist the Hanford Site emergency response organization in determining the accessibility of the areas or buildings during and after the emergency, and will evaluate the advisability of reentry. Current operating records and other information for evaluating the emergency will be used in making these decisions.

After the emergency has been terminated, and during recovery activities, the WTP recovery manager is responsible for reentry authorization.

The WTP will maintain emergency plan implementing procedures and operational procedures for estimating exposure to hazardous materials and for protecting workers and the general public from exposure during reentry and recovery activities. Reentry exposure conditions will be as described in DOE/RL 94-02.

15.4.7.3 Recovery

Upon termination of the emergency, the WTP and other Hanford Site organizations (as applicable) will develop and implement recovery plans in accordance with DOE/RL 94-02. Operations will restart in accordance with developed and approved plans. WTP recovery planning will include dissemination of information to offsite agencies regarding the emergency and relaxation of public protective actions, planning for decontamination actions, establishment of a recovery organization, and establishment of criteria for resumption of normal operations. The WTP will coordinate the accident investigation and ensure that actions are performed in accordance with the WTP contract and applicable regulations.

Planning and operations for Hanford Site recovery are described in DOE/RL 94-02. The WTP will support the Hanford Site for recovery actions from an emergency at the WTP.

The states of Washington and Oregon are responsible for determining when to begin relaxing protective measures, and will make offsite reentry and recovery decisions. The states will coordinate recovery activities with the affected counties, who will coordinate local public health actions and disaster assistance. The states will also coordinate recovery actions with the Hanford Site.

15.5 References

Project Documents

24590-WTP-ISMP-ESH-01-001, *Integrated Safety Management Plan.*

24590-WTP-SRD-ESH-01-001, *Safety Requirements Document.*

Codes and Standards

29 CFR 1910.120. "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*, US Department of Energy, Washington DC.

AEA. 1954. *Atomic Energy Act of 1954,* 42 USC Sect 2011, US Congress, Washington, DC.

DOE. 2000. *Emergency Plan Implementing Procedures*, DOE 0223, US Department of Energy, Washington, DC.

DOE-RL. 2001. *Hanford Emergency Management Plan*, DOE/RL 94-02, US Department of Energy, Richland, Washington.

EPA. 1991. *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*, EPA 400-R-92-001, US Environmental Protection Agency, Washington, DC.

RCRA. 1976. *Resource Conservation and Recovery Act of 1976,* 42 USC Section 6901, US Congress, Washington, DC.

WAC 173-303. "Dangerous Waste Regulations," *Washington Administrative Code.*

Table 15-1 Matrix of Accidents, Accident Types, Consequences, and Protective Actions

Accident Categories	Accident Type	Consequence	Protective actions
Radioactive material release	Loss of containment, criticality	Exposure of public, workers, or environment	Evacuation, sheltering, decontamination, relocation, access control, food control, personal protective equipment
Chemical release	Loss of confinement	Exposure of public, workers, and environment	Evacuation, sheltering, decontamination, relocation, access control, food control, personal protective equipment
Natural disasters	Earthquake	Damage to tank safety systems	Evacuation, sheltering, decontamination, relocation, access control, food control, personal protective equipment
Fires or explosions	Exothermic reactions	Personnel exposure to hazardous materials, injuries	Evacuation, decontamination, relocation, access control, personal protective equipment
Extrinsic hazards	Airplane crash	Personnel exposure, injuries	Evacuation, sheltering, access control, personal protective equipment (depending on event)
Waste disposal	Handling of waste materials	Direct exposure to ionizing radiation	Evacuation, decontamination, relocation, access control, personal protective equipment
Waste disposal	Movement of hazardous materials	Direct exposure to hazardous materials	Evacuation, decontamination, relocation, access control, personal protective equipment

Table 15-2 Summary of Emergency Classifications

Emergency Classification	Facility or Process Event	Transportation Event
Alert	Actual or potential substantial degradation of level of control over radiological or nonradiological hazardous material. Releases are not expected to exceed applicable PAG or ERPG levels at or beyond the facility boundary. OR Actual or potential substantial degradation in the level of safety or security that could, with further degradation, produce a Site Area Emergency or General Emergency.	Actual or potential substantial degradation of the safety of the shipment. Exposures in excess of PAG or ERPG levels expected only for personnel engaged in cleanup, recovery, and investigation.
Site Area Emergency	Actual or potential major failures of functions necessary for the protection of workers or the public. Releases could exceed applicable PAG or ERPG levels onsite but not offsite. OR Actual or potential major degradation in the level of safety or security that could, with further degradation, produce a General Emergency.	Actual or potential major reduction in safety of a shipment. Release may exceed PAG or ERPG levels beyond the exclusion zone onsite but not at nearest site boundary.
General Emergency	Actual or imminent catastrophic reduction of facility safety or security systems with potential for the release of large quantities of radiological or nonradiological materials to the environment. Releases reasonably expected to exceed applicable PAG or ERPG levels offsite.	Actual or imminent catastrophic reduction in safety of a shipment. Release expected to exceed PAG or ERPG levels offsite.

Table 15-3 WTP Emergency Classification Criteria

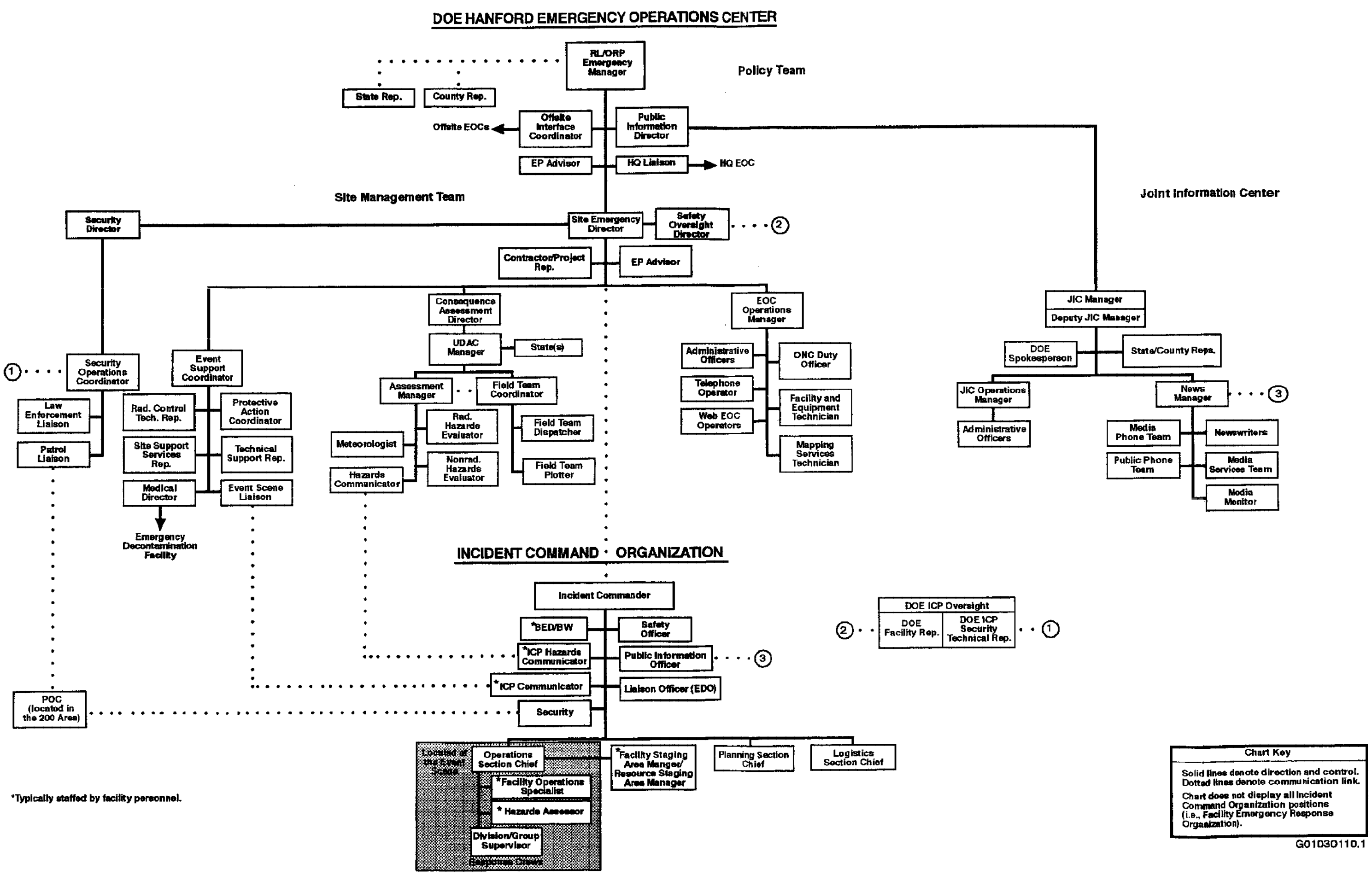
Alert	Site Area Emergency	General Emergency
≥ ERPG[a]-1 & < ERPG-2 at the facility boundary[b].	≥ ERPG-2 at the facility boundary.	≥ ERPG-2 at the Hanford Site boundary.
≥ 100 mrem TEDE[c] at the facility boundary.	≥ 1 rem TEDE at the facility boundary.	≥ 1 rem TEDE at the Hanford Site boundary.

[a]Appropriate ERPG values or equivalent as stated in the DOE *Emergency Management Guide*. Solubility class "D" uranium compounds are limited by chemical toxicity.

[b]The facility boundary is defined as the property protection area perimeter fence when present or a distance of 100 m from the release location unless otherwise specified in the hazards assessment documentation.

[c]The total effective dose equivalent (TEDE) includes the summation of the doses delivered from plume submersion, ground shine, and inhalation from accidental releases.

Figure 15-1 Hanford Site Emergency Response Organization



18 Fire Protection

Contents

18 Fire Protection

18.1 Introduction

This chapter demonstrates that the comprehensive fire protection program being developed will provide an acceptable level of safety from fires, chemical explosions, and related events at the River Protection Project - Waste Treatment Plant (WTP). The information will also confirm that the radiological consequences from such fires, chemical explosions, and related events have been considered and addressed. Significant aspects of the fire hazard analysis are also referenced.

18.2 Requirements

The requirements that form the basis for the fire protection program are found in section 4.5 of 24590-WTP-SRD-ESH-01-001, the *Safety Requirements Document*, Volume II. The *Safety Requirements Document* contains details including safety criteria and specific implementing codes and standards. These safety criteria, codes, and standards follow:

Safety Requirements Document

Chapter 4, "Engineering and Design"

Section 4.5, Fire Protection; Safety Criteria 4.5-12 through 4.5-23

Integrated Safety Management Plan

ISMP Section	WTP Project Integrated Safety Management Element	WTP Project Radiological, Nuclear, and Process Integrated Safety Management Coverage PSAR Vol. I Chapter 18
1.5	Hot Work Operations	18.5.1, "Administrative Procedures for Combustibles Control."

DOE G 440.1 *Implementation Guide for Use With DOE Orders 420.1 and 440.1, Fire Safety Program* (DOE 1995)

DOE-STD-1066-97, *Fire Protection Design Criteria* (DOE 1997)

National Fire Protection Association Standard 801 (NFPA 1998)

The *Safety Requirements Document* section 4.5 safety criteria not listed above relate to the design aspects of the fire protection program.

18.3 Organization and Management Control Systems

This section discusses the objectives of the WTP fire protection program, the management and staffing required for the program, and the requirements documentation associated with each of the facility phase of the project (such as construction, startup, operations).

18.3.1 Fire Protection Program

The WTP fire protection program and fire protection system design are implemented based on a defense-in-depth approach. Design and engineered features, in combination with management controls, achieve the following objectives:

- Prevent fires from starting
- Detect fires that do start, and alert fire fighting personnel
- Prevent the spread of fires and products of combustion by active and passive controls
- Rapidly control and extinguish fires through fire suppression systems or manual intervention

Design and engineering features are described in the General Information volume, section 2.7.2, Fire Protection, and in Chapter 2 of the facility-specific volumes. Features of the fire protection system design allow occupants to escape to a place of safety, protect equipment, minimize radiological and chemical exposure to personnel and the public, minimize fire spread, limit property loss, and prevent releases to the environment.

18.3.2 Positions, Authorities and Qualifications

Specific fire-safety roles and responsibilities for the fire protection program will be developed when the program structure is finalized. At that time, specific roles, activities, and a functional organization chart will be available.

18.3.3 Communication of Responsibilities

During design and construction of the WTP, the project manager is responsible for establishing the fire safety policy. Bechtel National, Inc. is responsible for designing a fire-prevention system that meets regulatory requirements and fire protection engineering principles. The Office of River Protection is the project's "Authority Having Jurisdiction" for approval of the final design.

18.3.4 Staffing

Individuals who develop the design of the fire protection system and specify fire protection equipment meet requirements to qualify as a member in the Society of Fire Protection Engineers. The Environmental Safety and Health organization is responsible for developing and implementing an effective fire-protection program. Environmental Safety and Health also functions as fire protection experts and implements a fire protection review, analysis, and approval function. Environmental Safety and Health will provide an individual who meets the requirements to qualify as a member in the Society of Fire Protection Engineers.

18.3.5 Requirements Documentation

The WTP uses the fire protection program to identify and eliminate or control fire hazards. The design of the WTP reflects the measures deemed appropriate to mitigate the risk from fire to personnel, property, and the environment by applying regulatory requirements and fire engineering principles. Fire safety policies and procedures are used to ensure that fire risks are controlled. For the startup and operational phases, these policies and procedures address the following topics:

- Fire safety training for WTP staff, emergency response personnel, and visitors
- Pre-fire plans
- Administrative procedures for performing work that may affect the fire safety arrangements of the facility, including the introduction of transient materials that could affect the fire severity or temporarily increase the fire loading of the area, and management controls of hot working operations (welding and cutting)
- Routine surveillance testing, maintenance, and servicing of fire protection systems and equipment
- Record keeping of maintenance and servicing of fire protection systems and equipment
- Administrative procedures for the assessment of the fire risk of new or replacement materials proposed for use at the facility
- Management plans for fire safety inspections to ensure that the integrity of the design has been maintained and that the control of fire risk remains effective
- Fire Prevention Program addressing subjects such as control of flammable and combustible materials, control of ignition sources, fire extinguisher use, and fire prevention training

18.4 Training and Qualifications

Training requirements and the necessary qualifications for personnel performing fire protection functions are discussed below.

18.4.1 Qualifications and Experience

Personnel performing fire protection functions and activities that affect plant fire safety will be qualified through training and experience in fire protection activities. These individuals will have the necessary experience in fire protection and will be familiar with the equipment associated with their position and responsibilities. In addition, these individuals will maintain their qualifications through required training.

18.4.2 Fire Hazard Recognition

WTP staff members will be required to complete basic fire safety training applicable to the current phase of the project. This training ensures that onsite personnel understand and recognize fire hazards present on the site, elements of the fire prevention program applicable to their responsibilities, and emergency response measures including means of egress and methods of reporting fires. Staff members periodically receive refresher training. Visitors and temporary employees receive instructions that identify evacuation routes and procedures for reporting fires. Periodic facility evacuation drills will also be conducted.

18.4.3 Operations and Maintenance Worker Training

Maintenance and operations personnel will receive fire safety training regarding design and maintenance of fire protection equipment, fire prevention techniques, and fire fighting principles and techniques. Training will also include familiarization with communications equipment, lighting systems, and ventilation systems for the facilities.

18.4.4 Emergency Response Team Training

The emergency response team members will be members of the Hanford Fire Department, will be trained to respond to events that may occur in radiological and hazardous material environments, and will be trained to coordinate with other emergency response organizations. Drills involving the Hanford Fire Department and emergency response organizations will also be conducted as part of this training.

18.5 Fire Prevention Program

A fire prevention program serves the purpose of identifies the commitments, documents, and activities necessary to protect the public, workers, and environment. The fire prevention program helps to implement the overall fire protection program.

18.5.1 Administrative Procedures for Combustibles Control

The fire prevention program will include the following:

- Personnel training on fire prevention, control of flammable and combustible materials, control of ignition sources, identification of steps to be taken if a fire protection system is impaired, and required compensatory measures
- Inspections of fire protection activities
- Procedures addressing the management controls for the project
- Procedures documenting the management policies and controls for the startup testing and operational phases

18.5.2 Supplemental Fire Protection Measures

The fire prevention program requires an evaluation of maintenance activities to identify those that could increase the likelihood of fire (such as cutting, grinding, welding, or other uses of an open flame). These activities require special precautions, including hot work permits. If needed, compensatory controls are established for activities that may impair fire prevention or mitigation features.

18.5.3 Review of Facility, Process, and Design Modifications

The WTP will periodically perform fire safety inspections to ascertain that fire defenses are in place, emergency equipment is readily available and in operating order, combustibles are held to minimal quantities, and housekeeping practices are maintained. Additionally, the WTP's overall performance in fire protection will be periodically evaluated through review of inspection reports, facility modifications, and incident reports. A qualified fired protection engineer will perform a documented review of plans, specifications, procedures, and acceptance costs related to fire safety.

18.5.4 Reporting and Investigation

Reporting and investigation of fires, chemical explosions, and related incidents will be handled in accordance with General Information volume, section 17.4.

18.5.5 Fire Barrier Penetration Protection and Tracking

The placement and modification of fire barrier penetration seals, doors, dampers, and related devices will be monitored and inspections, testing, and maintenance will be performed by qualified personnel.

18.5.6 Prioritized Fire Safety Issues Management

Fire safety issues will be identified through assessments, incidents, and facility modifications. Each fire safety issue will be identified and tracked to resolution in accordance with the WTP Quality Assurance program.

18.6 Fire Protection Features and Systems

The WTP fire protection features consider the structural aspects, electrical wiring, lightning protection, ventilation systems, emergency lighting, passive fire-rated barriers, detection and alarm systems, flammable or combustible liquid spill control, flammable gas control, water supply systems, control valves, fire suppression systems, fire protection equipment testing, and various fire suppression designs and construction materials. Details of these fire protection features are in the General Information volume, section 2.7.2, Fire Protection. Facility-specific fire protection features are described in the fire protection section of Chapter 2 of the respective facility-specific volume.

18.7 Manual Fire-Fighting Capability

18.7.1 Documentation of Minimum Required Capabilities

The WTP fire protection program will address the extent to which WTP site personnel will participate in manual fire fighting activities. Individuals involved in such activities will be appropriately trained under the Industrial Safety and Health Program. The Hanford Fire Department will have primary responsibility for manual fire fighting activities.

18.7.2 Organizational Responsibilities

During construction activities, the WTP Construction Manager will identify the specific organizational position responsible for coordination and liaison with offsite fire fighting resources.

18.7.3 Interface With Offsite Organizations

Formal agreements regarding the role and interface of the WTP site personnel and the Hanford Fire Department have been drafted and implemented for construction activities.

18.7.4 Emergency Response Team Capabilities

Emergency response activities will be performed by the Hanford Fire Department. A 1996 needs assessment (*Site Emergency Response Needs*, WHC-SP-1180 Vol. 1 and 2, [WHC 1996]) of the Hanford Fire Department documented current and future site operations and hazards, described the Hanford Fire Department in terms of organization, resources, and response capabilities, and identified regulatory and other requirements applicable to the Hanford Fire Department.

18.7.5 Pre-Fire Plans

The pre-fire plan will provide written directions for the following actions:

- Response to fire alarms and fire system supervisory signals
- Specific fire-mitigation activities for each fire confinement area
- Directions for personnel evacuation
- Notification of designated personnel and organizations
- Coordination with security forces, radiation protection personnel, and other designated personnel to admit offsite emergency vehicles and personnel
- Conduct of periodic coordinated drills and exercises to verify the adequacy of the pre-fire plan

18.8 Fire Hazard Analysis

The Preliminary Fire Hazard Analysis (PFHA), performed during the initial stages of design and construction, provides a comprehensive and qualitative assessment of the risk from fire. The PFHA was performed to ensure that the proposed buildings and processes can be safely controlled or stabilized during and after a fire event. The PFHA contains the specific information used to make those types of determinations. *Preliminary Fire Hazard Analysis (PFHA) For Low Activity Waste (LAW) Building*, 24590-LAW-RPT-ESH-01-001, and *Preliminary Fire Hazard Analysis (PFHA) For Balance of Facility (BOF) Buildings*, 24590-BOF-RPT-ESH-01-002, provide detailed information regarding the following:

- Construction type; fire
- Chemical explosion, and related hazards
- Fire protection features
- Critical process equipment
- Operations
- Potential for a toxic or radiation incident from a fire
- Impacts of natural hazards
- Life safety considerations
- Emergency planning
- Fire department or brigade response
- Protection of items important to safety
- Security and safeguards considerations related to fire protection
- Exposure fire potential and the potential for fire to spread between areas

18.9 Fire Protection for Filter Plenums

The PFHA discusses the fire protection considerations for the filter plenums, and section 2.7.2.1.5 of the General Information volume discusses C2/C3/C5 HEPA filter fire protection.

18.10 References

Project Documents

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document.*

24590-BOF-RPT-ESH-01-002, *Preliminary Fire Hazard Analysis (PFHA) for Balance of Facility (BOF) Building.*

24590-LAW-RPT-ESH-01-001, *Preliminary Fire Hazard Analysis (PFHA) for Low Activity Waste (LAW) Building.*

Codes and Standards

DOE. 1995. *Implementation Guide for Use with DOE Orders 420.1 and 440.1, Fire Safety Program,* DOE Order G-420.1/G-440.1, US Department of Energy, Washington, DC.

DOE. 1997. *Fire Protection Design Criteria,* DOE-STD-1066, US Department of Energy, Washington, DC.

NFPA. 1998. *Standard for Fire Protection for Facilities Handling Radioactive Materials,* NFPA 801, National Fire Protection Association, Quincy, Massachusetts.

Other Documents

WHC. 1996, *Hanford Site Emergency Response Needs,* WHC-SP-1180, Westinghouse Hanford Company, Richland, Washington.