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

03-OSR-0301

Mr. J. P. Henschel, Project Director
Bechtel National, Inc.
2435 Stevens Center
Richland, Washington 99352

Dear Mr. Henschel:

CONTRACT NO. DE-AC27-01RV14136 – SAFETY REQUIREMENTS DOCUMENT (SRD) DESIGN STANDARDS IMPLEMENTATION INSPECTION REPORT
A-03-OSR-RPPWTP-016

This letter forwards the results of the U.S. Department of Energy, Office of River Protection (ORP) inspection of Bechtel National, Inc. (BNI) SRD design standards implementation for the Waste Treatment and Immobilization Plant during the period July 21 through 25, 2003. For standards selection, the Contractor is required to follow the Integrated Safety Management (ISM) process described in Appendix A of the SRD. The primary focus of the inspection was to assess the Contractor's implementation of the design implementing codes and standards stipulated in the SRD. The inspection also assessed the Contractor's process for evaluating and dispositioning deviations from SRD implementing codes and standards.

The inspectors concluded that breakdowns occurred in both the Contractor's implementation of SRD design codes and standards and in the corrective action process for discrepancies identified in the implementation of SRD design codes and standards. These breakdowns are evidenced by the following:

- The two Findings are documented in the enclosed Notice of Finding (Enclosure 1). The first Finding concerns the Contractor's failure to meet contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN); specifically, for piping, pipe supports, and pump pressure casings, the Contractor failed to comply with the requirements of ASME B31.3-96 as required by SRD Safety Criterion 4.2-2. The second Finding concerns the Contractor's failure to take timely corrective actions to address the use of unapproved SRD design implementing codes and standards (IR-03-016-04-FIN); specifically, Decisions to Deviate were not prepared to document and inform DOE of design activities (i.e., use of ASME Section III for piping and pipe support design and API 610 and API 685 for pump pressure casings) known to not conform with the approved Authorization Basis.

- The Findings issued as the result of the SRD Design Codes and Standards Implementation inspection conducted September 16 to 20, 2002, addressed prior instances of the Contractor's failure to meet contractual requirements to implement the DOE-approved SRD. These included Findings IR-02-012-01a-FIN (use of unapproved design requirements and allowable stresses from ASME Section III instead of the

approved ASME Section VIII requirements for the design of pressure vessels) and IR-02-012-01b-FIN (use of unapproved design requirements and allowables from ASME Section III instead of the approved ANSI B31.1 requirements for the design of process piping).

- The Finding (IR-02-012-03-FIN) issued as the result of the SRD Design Codes and Standards Implementation inspection conducted September 16 to 20, 2002, that identified there was no documented evidence the Contractor had established a process that incorporated Human Factor Engineering in the facility design (i.e., documentation demonstrating implementation of IEEE 1023, Section 6.1, Task Analysis).

- The concerns regarding discrepancies identified in the Contractor's Electrical Design Criteria and Guide (24590-WTP-DC-E-01-001) that provided guidance to design engineers in conflict with SRD Safety Criteria as discussed in the Inspection Report, Section 1.4.2 (Enclosure 2). Specifically, the Guide did not include ashfall as a general site environmental condition (as required by SRD Safety Criterion 4.1-3), referenced IEEE Standard 1184 for sizing batteries that support uninterruptible power systems versus IEEE Standard 485 as required by SRD Safety Criterion 4.4-4, and did not identify the surge protection standards invoked by SRD Safety Criterion 4.4-4 implementing codes and standards.

Complete details of the inspection, including the Findings, are documented in the enclosed inspection report. You are requested to provide written responses to these Findings within 30 days, in accordance with the instruction provided in the Notice of Finding. Further, your response should address the actions being taken to effectively and promptly address the breakdowns in your processes for implementing SRD design codes and standards and tracking and correcting discrepancies identified in the implementation of those codes and standards.

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

Sincerely,

Roy J. Schepens
Manager

OSR:RWG

Enclosures (2)

cc w/encls.:
G. Shell, BNI

NOTICE OF FINDINGS

Section C, "Statement of Work," Standard 7, "Environment, Safety, Quality, and Health," of the Contract,[1] defined Bechtel National, Inc.'s (the Contractor) responsibilities under the Contract as they related to conventional non-radiological worker safety and health; radiological, nuclear, and process safety; environmental protection; and quality assurance.

Standard 7, Section (d) of the Contract required the Contractor to develop and implement an integrated, standards-based, safety management program to ensure that radiological, nuclear, and process safety requirements are defined, implemented, and maintained. The Contractor was required to conduct work in accordance with the Contractor-developed and U.S. Department of Energy (DOE)-approved Safety Requirements Document (SRD). The Contractor's SRD was defined in 24590-WTP-SRD-ESH-01-001-02, Rev. 2h, dated June 25, 2003.

Standard 7, Section (e)(3) of the Contract required the Contractor to develop and implement a Quality Assurance (QA) program, supported by documentation that describes the overall implementation of QA requirements. The documentation shall identify the procedures, instructions, and manuals used to implement the Contractor's QA program within the Contractor's scope of work. For radiological, nuclear, and process safety, QA is to be conducted in accordance with 10 CFR 830.120. The Contractor's QA program was documented in 24590-WTP-QAM-QA-01-001, *Quality Assurance Manual*, Revision 3, dated January 6, 2003.

During the performance of an inspection of the Standards Implementation Process conducted July 21-25, 2003, at the Contractor's offices, the following items were identified that did not meet the above cited requirements:

1. SRD Safety Criterion 4.2-2 required the Contractor to adhere to the requirements of the ASME Standard B31.3-96, *Process Piping,* for the design and analysis of piping, including seismic considerations. SRD Safety Criterion 4.2-2 made no reference to ASME Section III.

   Contrary to the above, Contractor Engineering Specifications 24590-WTP-DC-PS-01-001, Rev. 1, *Pipe Stress Design Criteria*; 24590-WTP-DC-01-PS-002, Rev. 1, *Pipe Support Design Criteria*; 24590-WTP-GPG-ENG-004, Rev. 0, *Engineering Design Guide for Pipe Stress, Pipe Layout and Pipe Spacing*; 24590-WTP-GPG-ENG-005, Rev. 0, *Engineering Design Guide for Pipe Supports*; Calculation 24590-LAW-P6C-LCP-00001, Rev A (Committed), *LAW Pipe Stress Calc. Pkg. (24590-LAW-P#-LCP-PB01369)*; Calculation 24590-PTF-P6C-PWD-00012, Rev A (Committed), *RPP-WTP-PWD-WT/WU System Pipe Stress*

[1] Contract No. DE-AC27-01RV14136, between U.S. Department of Energy and Bechtel National, Inc., dated December 11, 2000.

Analysis; Calculation 24590-PTF-PHC-PWD-00024, Rev A (Committed), *RPP-WTP Engineered Support Calculation*; and Calculation 24590-BOF-PHC-RLD-00001, Rev A (Committed), *Waste Transfer Lines Pipe Support Qualification* used ASME Section III allowable stresses in the seismic design and analysis of piping instead of ASME B31.3-96 allowable stresses.

SRD Safety Criterion 4.2-2 required the Contractor adhere to the requirements of the ASME standard B31.3-96, *Process Piping*, and ASME Section VIII, Boiler and Pressure Vessel Codes, *Rules for Construction of Pressure Vessels for the Design and Test of Pump Cases*. Both ASME B31.3-96 and ASME Section VIII contained provisions for the design and testing of centrifugal pumps. SRD Safety Criterion 4.2-2 made no reference to API-610 or API-685.

Contrary to the above, Contractor Engineering Specifications and Material Requisitions 24590-WTP-3PS-MPC0-T0001, Rev. 1, *Centrifugal Pumps to Meet Requirements of API Standard 610, Eighth Edition, and Quality Levels QL-1 and QL-2;* 24590-PTF-3PS-MPC0-T0001, Rev. 0, *PTF Hot Cell Slurry Pumps to Meet Requirements of API Standard 610, Eighth Edition;* 24590-WTP-3PS-MPC0-T0003, Rev. 0, *Sealless Centrifugal Pumps to Meet Requirements of API Standard 685, First Edition, and Quality Levels QL-1 and QL-2;* 2459-QL-MRA-MPC0-00004, Rev. 1, *Pumps, API-610 Slurry (N2KB) (Sensitive) (MS061)*; and 2459-QL-MRA-MPC0- 00005, Rev. 0, *Pumps, API-685 Sealless* used API-610 or API-685 pressure boundary and test attributes instead of those specified by ASME B31.3-96 and ASME Section VIII.

The above items are examples of a Finding for failure to meet contractual requirements to implement the DOE-approved SRD. (See IR-03-016, Section 1.3.2, IR-03-016-02-FIN)

2. QAM Policy Q-16.1 required that "Services and processes that do not meet established requirements are to be identified…, documented, controlled, and corrected…"

Contrary to the above, a Corrective Action Report (CAR) to address use of an unauthorized standard was not initiated after BNI withdrew Authorization Basis Amendment Request 24590- WTP-ABAR-ENS-03-002. The CAR was required by the Contractor's Corrective Action Procedure (24590-WTP-GPP-QA-201_5) and Quality Assurance Manual (QAM, 24590-QAM-QA-01-001, Rev. 4). In addition, a Decision to Deviate (DTD) from the Authorization Basis, as required by the Contractor's Authorization Basis Maintenance Procedure (24590-WTP-GPP- SREG-002, Rev. 5) was not prepared.

In addition and contrary to the above, a CAR was not issued to address the use of API-610 and API-685 standards instead of the SRD authorized codes and standards (ASME Section VIII and ASME B31.3-96) when BNI staff and management identified this discrepancy. Issuance of a CAR is required by BNI's

Corrective Action Procedure (24590-WTP-GPP-QA-201_5) and QAM (24590-QAM-QA-01- 001, Rev. 4). A DTD to document the Contractor's intention to deviate from the Authorization Basis, as required by the Contractor's Authorization Basis Maintenance Procedure (24590-WTP-GPP-SREG-002, Rev. 5) also was not prepared.

The above items are examples of a Finding for failure to meet contractual requirements to implement the DOE-approved QAM. (See IR-03-016, Section 1.3.2, IR-03-016-03-FIN)

Enclosure 2
03-OSR-0301

U. S. DEPARTMENT OF ENERGY
Office of River Protection

INSPECTION:	Safety Requirements Document Design Standards Implementation
REPORT NO.:	A-03-OSR-RPPWTP-016
FACILITY:	Bechtel National, Inc.
LOCATION:	3000 George Washington Way Richland, Washington 99352
DATES:	July 21 – 25, 2003
INSPECTORS:	R. Griffith, Inspection Lead B. Carpenter, Consultant J. Leivo, Consultant M. Shlyamberg, Consultant
APPROVED BY:	P. Carier, Verification and Confirmation Official WTP Safety Regulation Division

EXECUTIVE SUMMARY
Safety Requirements Document (SRD) Design Standards Implementation

INTRODUCTION

This inspection of the Bechtel National, Inc. (the Contractor) SRD design standards implementation process covered the following areas:

- Implementation of SRD Civil-Structural Design Standards. (Section 1.2)
- Implementation of SRD Mechanical Design Standards. (Section 1.3)
- Implementation of SRD Control, Electrical, Instrumentation, and Human Factors Design Standards. (Section 1.4)
- Implementation of SRD Mechanical (Ventilation) Design Standards. (Section 1.5)
- Implementation of SRD Fire Protection Design Standards. (Section 1.6)
- Deviations from the Implementation of SRD Design Standards. (Section 1.7)

SIGNIFICANT OBSERVATIONS AND CONCLUSIONS

- In the Civil-Structural building design and analysis area, the Contractor had properly implemented the civil/structural/ architectural design and analysis codes and standards stipulated in the SRD. However, for the design of piping and pipe supports, the Contractor has used a design code (American Society of Mechanical Engineers Section III) that deviated from those listed in the SRD. This discrepancy was identified in a previous inspection Finding (IR-02-012-01b-FIN) and had not been corrected. The Finding will remain open until proper closure can be verified by the Office of River Protection (ORP). (Section 1.2)

- In the mechanical design and analysis area, the Contractor had properly implemented the majority of the SRD codes and standards. However, for piping, pipe supports and pump pressure casings, the Contractor used design code and standards that were not identified in the SRD Safety Criteria (SC). This resulted in two examples of a Finding for failure to meet contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN). This Finding is significant because ORP's confidence in the safety basis for the WTP design rests, to a large degree, on the Contractor's proper implementation of the approved Integrated Safety Management (ISM) program. DOE has reviewed this program extensively and is confident that, properly implemented, the program will identify appropriate control strategies, including their implementing codes and standards, for hazards associated with WTP operation. This Finding reflects a breakdown in the Contractor's ISM program. (Section 1.3)

- Also in the mechanical design and analysis area, although Contractor staff and management were aware of the non-compliance, the Contractor failed to take appropriate corrective actions to address the use of unapproved codes and standards. This resulted in two examples of a Finding for failure to meet contractual requirements to implement the DOE-approved Quality Assurance Manual (IR-03-016-04-FIN). This Finding is of particular concern to ORP, because it involves design work occurring over a period of several months that deviated from the approved SRD and is potentially unacceptable. As identified during the inspection, the Contractor does not have a process in place to readily identify and correct design output documentation impacted by the deviation in the event that ORP disagrees with the SRD implementing codes and standards noncompliance. This could result in a significant impact to the project design effort. ORP expects the Contractor to promptly initiate the appropriate engineering (Decision to Deviate, DTD) and Quality Assurance (Corrective Action Report, CAR) documentation whenever a noncompliance with SRD implementing codes and standards is identified. (Section 1.3)

- In the electrical, control, and instrumentation design area, the Contractor was almost entirely in preliminary status, with work in progress. Contractor personnel had a good understanding of the safety significance of the Institute of Electrical and Electronics Engineers, Inc. and Instrument Society of America implementing codes and standards identified for the SRD SC. Personnel who were not intimately familiar with a particular code or standard knew whom to contact within their organization for assistance in application or interpretation of the code or standard, and expressed their opinion that such a person was available for this assistance. Except for the Electrical Design Criteria and Guide, the inspectors did not identify any discrepancies in the design documents. Contractor personnel stated their intention to address discrepancies to the Electrical Design Criteria and Guide in a forthcoming revision. (Section 1.4)

- The design of the High Level Waste (HLW) C5 ventilation system ducting, fans, and HEPA filters was determined to have properly implemented the requirements of SRD Safety Criterion 4.4-6 implementing codes and standards. (Section 1.5)

- Contractor personnel were adequately knowledgeable of SRD Section 4.5 SC and implementing codes and standards requirements for the design and construction of Waste Treatment and Immobilization Plant (WTP) fire protection structures, systems, and components. Design documentation for WTP building fire barriers, fire barrier penetration seals, fire detection and alarm systems, fire suppression sprinkler systems, and building floor drainage systems was generally acceptable and compliant with SRD implementing codes and standards. The issue with the use of code editions for daughter standards referenced in SRD Section 4.5 SC implementing codes and standards that were not consistent with the approved Authorization Basis had been identified by the Contractor and documented in a Corrective Action Report (CAR). The design of WTP building drain systems was progressing in accordance with conditions of approval documented in the Safety Evaluation Reports for the Construction Authorization Requests. (Section 1.6)

- Although specific instances of weaknesses in the process were identified, Contractor personnel were otherwise knowledgeable of Contract and Authorization Basis requirements and process for correcting deviations from SRD implementing design codes and standards. (Section 1.7)

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1.0 REPORT DETAILS

1.1 Introduction

Standard 7, "Environment, Safety, Quality, and Health," Table S7-1, "Radiological, Nuclear, and Process Safety Deliverables," of the Contract, DE-AC27-01RV14136, dated December 11, 2000, between Bechtel National, Inc. (the Contractor) and the U.S. Department of Energy (DOE), required the Contractor to submit a SRD as part of the River Protection Project Waste Treatment and Immobilization Plant (WTP) design and supporting documentation. As described in Standard 7, Section d, the SRD is the set of environment, safety, quality, and health (ESQ&H) tailored requirements as referenced in Section I Clause entitled, "Laws, Regulations, and DOE Directives." These requirements include both the safety criteria (SC) and implementing codes and standards specified in Volume II of the SRD. The objectives of this inspection were to assess the adequacy of the Contractor's implementation of the SRD implementing codes and standards into the WTP design and the Contractor's process for dispositioning deviations from these codes and standards.

The Contractor's SRD Appendix A, *Implementing Standard for Safety Standards and Requirements Identification*, described the Contractor's commitment to implement an integrated safety management (ISM) process that meets requirements of Standard 7, Paragraph (e)(2)(i) of the Contract and DOE/RL-96-0004.

The Contractor established procedures 24590-WTP-GPP-SANA-002, Rev. 6, *Hazard Analysis, Development of Hazard Control Strategies, and Identification of Standards*, (SANA-002) dated April 11, 2003, and 24590-WTP-GPG-SANA-002, *Integrated Safety Management,* for implementing the requirements of SRD Appendix A. These procedures implemented the details of the Contractor's hazards analysis, accident analysis, and standards selection processes the Contractor collectively referred to as the ISM process. These same procedures had been reviewed in a number of past DOE Office of River Protection (ORP) assessments and had been considered extensively during the Standards Selection and Construction Authorization regulatory actions. For these reasons, this assessment did not include a programmatic assessment of ISM process described in SANA-002. Rather, the inspection concentrated on the implementation of the design standards identified through application of the process.

The Contractor had organized the programmatic implementation of the ISM process into "ISM Cycles" that correspond to key project milestones and DOE authorization actions. Cycle II ISM activities, which were associated with construction authorization and preparation of the Preliminary Safety Analysis Report (PSAR), had been completed at the time of the inspection. The project was early in the ISM Cycle III process. The inspectors determined the Contractor had planned to conduct ISM Cycle III activities throughout much of the construction phase of the WTP. The project schedules showed the completion of ISM Cycle III was tied to completion of

detailed WTP design and commencement of the cold-commissioning phase of the project. ISM Cycle II results were presented in the PSAR and SRD submitted in connection with the construction authorization regulatory action. Since these documents were subjected to an extensive review associated with the construction authorization regulatory action, this assessment focused on the implementation of the design standards identified as the result of ISM Cycle III activities.

In April of 2003, the Contractor performed a Management Assessment of the implementation of SRD design standards in project specifications. The assessment of a sample of specifications identified numerous issues with the implementation of SRD design standards and "daughter" standards, related to the code effective dates. Based on this assessment, the Contractor identified a number of corrective actions tracked to implementation by Corrective Action Report (CAR) 24590-WTP-CAR-QA-03-103 (CAR-03-103). These included a 100% review of important-to-safety (ITS) civil structural specifications, a sample review of ITS specifications for all other disciplines, and a review of a sample of other ITS engineering products. During the inspection, the Contractor informed the team that, based on the results of the initial review, CAR-03-103 was designated as significant and expanded in scope to include review of all ITS specifications in all disciplines. As confirmed at the inspection Exit Meeting, the expansion was to include a 100% review of engineering specifications in all discipline area and vertical slice or sampling reviews for design calculations and drawings. If problems were found in the review of calculations and drawings, the Contractor was prepared to expand the scope of the review, as necessary. Based on this change in scope, it was decided that discrepancies identified by the inspection team related to code effective dates would not be considered as Findings.

The inspectors used the guidance in Inspection Technical Procedure (ITP) I-110, *Safety Requirements Document Design Standards Implementation Assessment*, Revision 4, dated May 30, 2003, as a general basis for the inspection.

1.2 Implementation of SRD Civil-Structural Standards (ITP I-110)

1.2.1 Inspection Scope

This part of the inspection was to verify, by interviewing Contractor personnel and reviewing selected design documents, the Contractor was implementing design codes and standards for the civil-structural engineering and design of important-to-safety (ITS) buildings and structures, including piping and pipe supports, as specified in SRD Safety Criteria (SC) 4.1-2, 4.1-3, and 4.1-4. The verification was to ensure the following:

- Applicable nominal loads (dead, live, soil, wind, snow, flood, and earthquake) for building designs were specified and accounted for in accordance with American Society of Civil Engineers (ASCE) 7-98. (SRD SC 4.1-2, -3 and -4)

- The damping factor used for seismic analysis was in accordance with ASCE 4-98, Section 3.1. (SRD SC 4.1-2)

- Seismic Analysis for structures was performed in accordance with ASCE 4-98. (SRD SC 4.1-2)

- Stresses in steel structures were specified in accordance with American Institute of Steel Construction (AISC) N690-94. (SRD SC 4.1-2)

- Piping systems supports met the requirements of American Society of Mechanical Engineers (ASME) B31.3-96. (SRD SC 4.2-2)

The following inspection area was from ITP I-110 was not reviewed as part of this inspection:

- Concrete/rebar materials and cement/water ratios are specified in accordance with American Concrete Institute (ACI) 349-01. (SRD SC 4.1-2)

This area has been extensively reviewed by ORP and ORP consultants and was omitted from the inspection to allow for increased focus on ongoing civil, structural, and architectural design activities (i.e., steel design and detailing) and review of the closure status of items from previous inspections.

1.2.2 Observations and Assessments

The inspectors reviewed the following calculations, procedures, and specifications to assess the Contractor's implementation of SRD civil-structural design standards.

- Calculation 24590-BOF-S0C-80-00001, Rev. 0, *Design Earth Pressure on ITS Manholes*

- Calculation 24590-BOF-DBC-50-00005, Rev. A, *ITS Electrical Manhole Design Calculation*

- Calculation 24590-PTF-SSC-S15T-00001, Rev. A, *Design of Miscellaneous Steel in the Tunnels for PT Building*

- Calculation 24590-PTF-SSC-S15T-00034, Rev. A, *Design of Pipe Supports at Main Pit and Manifold Support in South Tunnel for PT Building*

- Calculation 24590-PTF-SSC-S15T-00034, Rev. A

- Drawing 24590-PTF-SS-S15T-00300, Rev. 2, *PTF Structural, Misc. Support Steel, Pipe Supports – Main Pit*

- Drawing 24590-PTF-SS-S15T-00304, Rev. 0, *PTF Structural, Misc. Support Steel, Sections – Main Pit*

- Drawing 24590-PTF-SS-S15T-00350, Rev. 2, *PTF Structural, Misc. Support Steel, Details, Sh 1*

- Calculation 24590-LAW-P6C-LCP-0001, Rev. A, *LAW Pipe Stress Calc. Pkg. (24590-LAW-P3-LCP-PB01369)*
- Design Criteria Document 24590-WTP-DC-PS-01-001, Rev. 1, *Pipe Stress Design Criteria*
- Design Criteria Document 24590-WTP-DC-PS-01-002, Rev. 1, *Pipe Support Design Criteria*
- Engineering Design Guide 24590-WTP-GPG-ENG-004, Rev. 0, *Engineering Design Guide for Pipe Stress, Pipe Layout and Pipe Spacing*
- Engineering Design Guide 24590-WTP-GPG-ENG-005, Rev. 0, *Engineering Design Guide for Pipe Supports*
- Engineering Specification 24590-WTP-3PS-SS01-T0001, Rev. 1, *Engineering Specification for Purchase of Miscellaneous Steel*
- Engineering Specification 24590-WTP-3PS-SS01-0002, Rev. 2, *Engineering Specification for Purchase of Structural Steel*
- Specification 24590-WTP-3PS-MV00-T0001, Rev. 1, *Pressure Vessel Design and Fabrication*
- Specification 24590-WTP-3PS-MV00-T0002, Rev. 1, *Seismic Qualification Criteria for Pressure Vessels*

The inspectors concluded the loads considered in Calculations 24590-BOF-S0C-80-00001 and 24590-BOF-DBC-50-00005 were consistent with 24590-WTP-DC-ST-001, Rev. 1, *Structural Design Criteria* and ASCE 7-98. The analysis appropriately considered all required loads for ITS equipment per SRD SC 4.1-3, including dead, live, seismic, and snow loads. The design calculation did not explicitly address ashfall. However, the inspectors determined ASCE 7-98 did not require ashfall and snow loads to be combined; therefore, the inspectors found the inclusion of only the snow load acceptable for concrete design.

The inspectors determined that Calculations 24590-PTF-SSC-S15T-00001 and 24590-PTF-SSC-S15T-00034 used in-structure response spectra with a damping factor of 4%. The inspectors found the methodologies used to apply seismic loads (i.e., equivalent static using the peak of the response spectrum and the spectral acceleration for the fundamental mode with an appropriate factor) were consistent with the *Structural Design Criteria* (24590-WTP-DC-ST-001, Rev. 1). Therefore, the inspectors concluded these calculations properly applied the correct damping values and analytical methods as defined in ASCE 4-98.

The inspectors reviewed Calculation 24590-PTF-SSC-S15T-00034, Rev. A that provided the structural analysis of the pipe support frame shown on drawings 24590-PTF-SS-S15T-00300, 24590-PTF-SS-S15T-00304, and 24590-PTF-SS-S15T-00350. The inspectors determined the analysis was performed in accordance with AISC N690-94. Although the structural calculation

did not contain thorough documentation of the evaluations performed against the requirements of AISC N690-94 (e.g., the evaluation of the connection shown in Detail 6 on drawing 24590-PTF-SS-S15T-00350 did not clearly identify the condition being considered and how like connections were qualified based on the analysis documented), the inspectors found sufficient information in the calculation to determine the connections were qualified with respect to AISC N690-94.

The inspectors reviewed Calculation 24590-LAW-P6C-LCP-0001 and determined this piping analysis for encased piping used material damping values were in accordance with ASME Code Case N-411 for the dynamic modal response spectrum analysis. Further, the inspectors determined these damping values were in accordance with the SRD, Appendix C, Section 2.0, DOE-STD-1020-94.

The inspectors reviewed project design documents 24590-WTP-DC-PS-01-001, 24590-WTP-DC-PS-01-002, 24590-WTP-GPG-ENG-004, and 24590-WTP-GPG-ENG-005, and determined these design documents invoked the requirements from ASME Section III, Subsections NC, NF, and Appendix F for analysis and allowable stresses for seismic design for piping and pipe supports. SRD SC 4.2-2 required the use of ASME B31.3-96 and made no reference to ASME Section III. This failure to meet Contractual requirements to implement the DOE-approved SRD was identified in a previous inspection (IR-02-12, Finding IR-02-012-01b-FIN) and had not been corrected. Therefore, this finding will remain open until an appropriate Authorization Basis Amendment Request is submitted by the Contractor, approved by ORP, and verified as properly implementing in a subsequent ORP inspection. A new Finding (IR-03-016-03-FIN) concerning the Contractor's inappropriate use of ASME Section III analysis and allowable stresses is discussed in Section 1.3.2 of this report.

The inspectors reviewed 24590-WTP-SRD-ESH-01-001-02, Rev. 2h, *Safety Requirements Document, Volume II* and 24590-WTP-DC-ST-01-001, Rev. 1, *Structural Design Criteria* to assess the Contractor's implementation of daughter standards of SRD implementing codes and standards in the design process. SRD SC 4.1-2, -3, and -4 included AISC N690-94 and ACI 349-01 as implementing standards, as tailored in SRD Appendix C, Sections 3.0 and 6.0, respectively. Both standards referenced other ("daughter") standards to support the implementation of the requirements. Due to the difference in issue dates for the two codes, there were conflicts in the applicable "daughter" standards.

- AISC N690-94 included ACI 349-90 and ASCE 7-88 as "daughter" standards, but identified code editions that conflicted with the code editions for ACI 349-01 and ASCE 7-98 as identified in SRD SC 4.1-2, -3, and -4.

- ACI 349-01 included ASCE 7-95 as a "daughter" standard, which conflicted with ASCE 7-98 as identified in SRD SC 4.1-2, -3 and -4.

The *Structural Design Criteria* included the *Code of Standard Practice for Steel Buildings*, March 7, 2000, and *Specification for Structural Joints Using ASTM A325 or A490 Bolts*, June 23, 2000 as applicable codes and standards. These versions of the standards are in conflict with the versions included in AISC MO16, *Manual of Steel Construction*, 9th Edition, and AISC N690-94 from SC 4.1-2, 3, and 4. The inspectors expect these discregancies to be corrected as part of the corrective action for Contractor CAR 24590-WTP-CAR-QA-03-103.

The inspectors reviewed Decision to Deviate (DTD) 24590-WTP-DTD-CSA-03-002, Rev. 0, *Decision to Deviate from the Authorization Basis*, and Engineering Specifications 24590-WTP-3PS-SS01-T0001 and 24590-WTP-3PS-SS01-0002 to further assess the Contractor's implementation of SRD implementing codes and standards in the design process. The DTD documented the decision to use the 2000 version of American Welding Society (AWS) D1.1, *Structural Welding Code – Steel,* in lieu of the 1992 version referenced in AISC N690-94. However, the specifications identified above (24590-WTP-3PS-SS01-T0001, Rev. 1 and 24590-WTP-3PS-SS01-0002, Rev. 2) referenced the 2002 version of AWS D1.1. This was inconsistent with the versions included in both AISC N690-94 and the DTD. The Contractor was aware of the inconsistency in reference year for AWS D1.1, but had not resolved the errors. Because the inspectors expect this discrepancy corrected as part of the corrective actions for Contractor CAR 24590-WTP-CAR-QA-03-103, a separate Finding was not identified and the resolution of this issue will be tracked as an Assessment Follow-up Item (AFI) (IR-03-016-01-AFI).

The inspectors reviewed Specifications 24590-WTP-3PS-MV00-T0001 and 24590-WTP-3PS-MV00-T0002 for implementation of SRD SC 4.2-2 implementing codes and standards. Prior revisions of these specifications included reference to ASME Section III, Subsection NC, NF, and Appendix F for analysis and allowable stresses for the seismic design of vessels and vessel supports. Finding IR-02-012-F01a documented the failure to meet Contractual requirements to implement the DOE-approved SRD, in that SRD SC 4.2-2 required these vessels to be design and constructed to the requirements of ASME Section VIII. The current revisions of these specifications did not reference the design requirements of ASME Section III, but only the requirements of ASME Section VIII. The inspectors concluded this was in accordance with SRD SC 4.2-2 and acceptable.

1.2.3 Conclusions

The inspectors concluded the Contractor had properly implemented the civil/structural/ architectural design and analysis codes and standards stipulated in the SRD. However, for the design of piping and pipe supports, the Contractor used a design code (ASME Section III) that deviated from those listed in the SRD. This failure to meet Contractual requirements to implement the DOE-approved SRD was identified in a previous inspection (IR-02-12, Finding IR-02-012-01b-FIN) and will remain open until an appropriate Authorization Basis Amendment Request is submitted by the Contractor, approved by ORP, and verified as properly implementing in a subsequent ORP inspection.

1.3 Implementation of SRD Mechanical Design Standards (ITP I-110)

1.3.1 Inspection Scope

This part of the inspection was to verify, by interviewing Contractor personnel and reviewing selected design documents, the Contractor was implementing design codes and standards for ITS piping and components, such as tanks, valves, pumps, and heat exchangers, as specified in SRD SC 4.1-3, 4.2-2, 4.4-2, and 4.4-20. The verification was to ensure:

- Designated piping materials complied with Chapter VIII, Part 7, of ASME B31.3-96, *Process Piping Code*, Category M. (SRD SC 4.2-2)

- Stipulated welding requirements complied with Chapter VIII, Part 9, Paragraph M328, of ASME B31.3-96. (SRD SC 4.2-2)

- Stipulated piping component material complied with Chapter VIII, Part 8, Paragraph M326, of ASME B31.3-96. (SRD SC4 2-2)

- Seismic design criteria stipulated for piping systems addressed criteria for earthquakes and other loading factors as required by DOE-STD-1020-94. (SRD SC 4.1-3)

- Pressure vessels, heat exchangers, and the pressure-retaining parts of pumps and valves were designed in accordance with the ASME Boiler and Pressure Vessel (B&PV) Section VIII. (SRD SC 4.2-2)

- Valve operators were environmentally qualified in accordance with Institute of Electrical and Electronics Engineers, Inc. (IEEE) 323-83. (SRD SC 4.4-2)

- Heat Exchanger shell minimum thickness was in accordance with recommendations of the Tubular Exchanger Manufacturer's Association (TEMA). (SRD SC 4.4-20).

1.3.2 Observations and Assessments

The inspectors reviewed several engineering specifications for piping and component materials, seismic design criteria for piping systems, pressure vessels and heat exchangers, and heat exchanger shell minimum thickness and determined the specifications were in accordance with SRD SC 4.1-3, 4.2-2, 4.4-2, and 4.4-20.

- Engineering Specification 24590-WTP-3PS-MV00-T0001, Rev. 1, *Pressure Vessel Design and Fabrication.* Section 2 of the specification listed required codes and standards. ASME Section VIII was included in the list as required by SRD SC 4.2-2. Section 3.2.1 of the specification required seismic analyses performed in accordance with the requirements of 24590-WTP-3PS-MV00-T0002, *Seismic Qualification Criteria for Pressure Vessels*.

- Engineering Specification 24590-WTP-3PS-MV00-T0002, Rev. 1, *Seismic Qualification Criteria for Pressure Vessels.* Section 2 of the specification listed required codes and standards. DOE-STD-1020-94 was included in the list as required by SRD SC 4.1-3.

- Engineering Specification 24590-WTP-3PS-MVB2-T0001, Rev. 1, *Welding of Pressure Vessels, Heat Exchangers and Boilers*. Section 3 of the specification listed required codes and standards. Although Section 3 did not directly reference ASME B31.3-96, as required by SRD SC 4.2-2, it did contain it by reference. Section 3 of the specification included ASME Section IX, *Welding and Brazing Qualifications*. ASME B31.3-96, Paragraph 328.2.1, required qualification of welding procedures and the performance of welders to conform to the requirements of ASME

Section IX. The inspectors determined this was satisfactory.

- Engineering Specification 24590-WTP-3PS-P000-T0001, Rev. 2, *Piping Material Classes*. Section 5 of the specification required the piping to meet the applicable design codes in attached piping class sheets, and those sheets included ASME B31.3-96, as required by SRD SC 4.2-2.

- Engineering Specification 24590-WTP-3PS-PB01-T0001, Rev. 0, *Technical Supply Conditions for Pipe, Fittings, and Flanges*. The specification's scope applied to all material requisitions for pipe, fittings, and flanges purchased per the requirements of the referenced codes as listed in Section 2 of the specification. Section 2 included ASME B31.3-96, as required by SRD SC 4.2-2.

- Engineering Specification 24590-WTP-3PS-PS02-T0001, Rev. 2, *Shop Fabrication of Piping*. Section 1.4 listed required codes and standards. ASME B31.3-96 was included in the list, as required by SRD SC 4.2-2.

- Engineering Specification 24590-WTP-3PS-MES0-T0001, Rev. 0, *Shell and Tube Heat Exchangers*. Section 2.2 of the specification listed ASME Section VIII, as required by SRD SC 4.2-2. Section 3.7.1 of the engineering specification discussed minimum shell thickness and stated the minimum shell thickness, exclusive of corrosion allowance, must be the greater of ¼ inch or TEMA minimums. Section 3.9 discussed expansion joints and noted, in Section 3.9.3, the minimum thickness must satisfy both TEMA and ASME Section VIII, Division 1, requirements. Thus, the inspectors concluded that SRD SC 4.4-20 was satisfied.

The inspectors reviewed the engineering specification for pipe welding requirements (Engineering Specification 24590-WTP-3PS-NWP0-T0001, Rev. 1, *General Welding and NDE Requirements for Supplier Fabricated Piping*) and identified the specification did not correctly implement the requirements of SRD SC 4.2-2. Specifically, Section 2.1.1 of the specification listed required codes and standards; however, ASME B31.3-96 (an SRD SC 4.2-2 implementing code) was not listed. Instead, ASME/ANSI B31.1, *Chemical and Refinery Process Piping*, was referenced. Since the title of the code was correct for the SRD SC 4.2-2 implementing code (ASME B31.3-96), the inspectors concluded this was a typographical error in the specification and brought this to the attention of the Contractor during the inspection exit meeting.

The inspectors reviewed several engineering design specifications, criteria, guides and calculations related to the implementation of the seismic design criteria for piping systems and supports. This review identified that the seismic design was not in accordance with the requirements of SRD SC 4.2-2. Specifically, these design documents invoked the requirements from ASME Section III, Subsections NC, NF and Appendix F for analysis and allowable stresses for the seismic design of piping, while SRD SC 4.2-2 required the use of ASME B31.3-96 and made no reference to ASME Section III. ASME B31.3-96 had requirements for seismic design that could have been applied to WTP piping and pipe supports. However, the Contractor was using ASME Section III allowable stresses, which were generally higher than those allowed by ASME B31.3-96 for seismic loadings. Using the higher ASME Section III allowable stresses could result in a less robust design. The use of ASME Section III, for the analysis and acceptance, was not in accordance with SRD SC 4.2-2. The Contractor continued to use

these criteria for calculations even after being notified by DOE[1] that review of the Authorization Basis Amendment Request (ABAR) 24590-WTP-ABAR-ENS-03-002 requesting ORP approval for use of the ASME Section III allowable stresses was suspended pending Contractor submittal of a revised ABAR. The revised ABAR had not been submitted to DOE at the time of this inspection. The continued use of unapproved criteria is considered a Finding for failing to meet Contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN).

The issue of using ASME Section III analysis and allowable stresses was previously identified during last year's Standards Selection Inspection and tracked for closure as Finding IR-02-012-01b-FIN. The closure of the OSR Standards Selection Inspection Findings [IR-02-012-01a-FIN (use of ASME Section III analysis and allowable stresses for pressure vessels) and IR-02-012-01b-FIN (use of ASME Section III analysis and allowable stresses for piping)] was tracked by the Contractor as Corrective Action Report Number 24590-WTR-CAR-QA-02-269 (CAR-02-269). The Contractor closed CAR-02-269 on March 21, 2003 by issuance of 24590-WTP-ABAR-ENS-02-005 for pressure vessels and 24590-WTP-ABAR-ENS-03-002 for piping. DOE subsequently approved a revised 24590-WTP-ABAR-ENS-02-005; however, following numerous meetings with ORP, the Contractor withdrew 24590-WTP-ABAR-ENS-03-002.

The inspectors determined the Contractor closeout of the corrective actions associated with the OSR Standards Selection inspection Findings to be inappropriate; however, the Corrective Action Procedure (24590-WTP-GPP-QA-201_3) in force at the time of CAR closure (March 21, 2003) allowed such action. This procedure was subsequently revised to require closure of such CARs "only… after receipt of the external agency acceptance of the proposed corrective actions…" Because the Contractor had revised their Corrective Action Procedure, the inspectors did not categorize this issue as a Finding.

Following the Contractor's withdrawal of 24590-WTP-ABAR-ENS-03-002 (intended to close OSR Standards Selection Inspection Finding IR-02-012-01b-FIN), the Contractor continued to use the ASME Section III methodology and acceptance criteria (for piping and pipe support calculations). A CAR to address use of the unauthorized standard was not initiated after the Contractor withdrew 24590-WTP-ABAR-ENS-03-002, as required by the Contractor's Corrective Action Procedure (24590-WTP-GPP-QA-201_5) and Quality Assurance Manual (QAM, 24590-QAM-QA-01-001, Rev. 4). QAM Policy Q-16.1 required "services and processes that do not meet established requirements are to be identified…, documented, controlled, and corrected …." Also, a DTD to allow deviation from the Authorization Basis, as required by the Contractor's Authorization Basis Maintenance Procedure (24590-WTP-GPP-SREG-002, Rev. 5), was not prepared. The Contractor had no process for identifying the engineering, procurement and construction documentation affected by the deviation, in the event that subsequent approval of the ABAR was denied by ORP. Following discussions between the inspectors and Contractor personnel, the Contractor issued Level 2 CAR 24590-WTP-CAR-QA-03-152 to address the lack of a DTD and continued use of an unapproved standard. Because the Contractor issued a CAR only after this issue was identified by the inspection team, this was a considered a Finding for failing to meet the contractual requirement to implement the DOE-approved QAM (IR-03-016-04-FIN).

[1] ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Suspension of Authorization Basis Amendment Request (ABAR) 24590-WTP-ABAR-ENS-03-002, Revision 0, Seismic Design of Piping Review," 03-OSR-0153, dated April 16, 2003.

The inspectors reviewed approved engineering design specifications and material requisitions (MRs) for centrifugal pumps to assess compliance with SRD SC implementing codes and standards and identified the pressure boundary design and test attributes were not in accordance with the requirements of SRD SC 4.2-2.

- 24590-WTP-3PS-MPC0-T0001, Rev. 1, *Centrifugal Pumps to Meet Requirements of API Standard 610, Eighth Edition, and Quality Levels QL-1 and QL-2.* The pressure boundary requirements of this specification were based on API 610 and not ASME Section VIII and ASME B31.3-96, as required by SRD SC 4.2-2. Additionally, this specification allowed for certain pumps to be hydro tested at the maximum allowable working pressure (MAWP) and not at 1.5 times the design pressure, as required by ASME Section VIII and ASME B31.3-96. Finally, this specification did not require use of mechanical seals in order to meet the SRD SC 4.2-2 confinement requirements. Contractor personnel stated that this specification was not and will not be used for procurement and should have been voided. **Note:** subsequent to the inspection, the inspectors were informed by the Contractor that CAR 24590-WTP-CAR-QA-03-160, *API-610 and API-685*, was issued on July 28, 2003 to address the deficiencies with the pump standards and requirements.

- 24590-PTF-3PS-MPC0-T0001, Rev. 0, *PTF Hot Cell Slurry Pumps to Meet Requirements of API Standard 610, Eighth Edition.* The pressure boundary requirements of this specification were based on API 610 and not ASME Section VIII and ASME B31.3-96, as required by SRD SC 4.2-2.

- 24590-WTP-3PS-MPC0-T0003, Rev. 0, *Sealless Centrifugal Pumps to Meet Requirements of API Standard 685, First Edition, and Quality Levels QL-1 and QL-2.* The pressure boundary requirements of this specification were based on API 685 and not ASME Section VIII and ASME B31.3-96, as required by SRD SC 4.2-2.

- 24590-QL-MRA-MPC0-00004, Rev. 1, *Pumps, API-610 Slurry (N2KB) (Sensitive) (MS061)*. The data sheet included in this MR did not establish a minimum acceptable design pressure to meet the ASME B31.3-96 and ASME Section VIII requirements.

- 24590-QL-MRA-MPC0-00005, Rev. 0, *Pumps, API-685 Sealless*. The data sheet included in this MR did not establish a minimum acceptable design pressure to meet the ASME B31.3-96 and ASME Section VIII requirements.

The specifications and MRs invoked the requirements from American Petroleum Institute (API) Standards 610 and 685, while SRD SC 4.2-2 listed ASME B31.3-96 and ASME Section VIII as implementing codes and standards. The pressure boundary requirements for centrifugal pumps, as specified in the Contractor's Design Guide 24590-WTP-GPG-M-017, Rev. 2, *Design Parameters & Test Pressures for Equipment and Piping*, would have met the design pressure requirements stipulated in ASME B31.3-96 and ASME Section VIII; however, these requirements were not translated in the pump specifications or data sheets attached to MRs. Additionally, the inspectors identified that neither the specifications nor the pump data sheets included with the MRs established a minimum acceptable design pressure to meet the ASME B31.3-96 and ASME Section VIII requirements. The Contractor failed to prepare and submit documentation requesting the use of implementing standards (i.e., API Standards

610 and 685) other than those specified in SRD SC 4.2-2 (ASME Section VIII and ASME B31.3-96). This was considered another example of the Finding for failing to meet contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN).

Contractor staff and management stated that the issue with use of API-610 and API-685 instead of ASME Section VIII and ASME B31.3-96 and the potential deviation with SRD SC 4.2-2 was known for at least a year. However, the Contractor had not initiated a CAR as required by the Contractor's Corrective Action Procedure (24590-WTP-GPP-QA-201_5) and Quality Assurance Manual (QAM, 24590-QAM-QA-01-001, Rev. 4). Also, a DTD to allow deviation from the Authorization Basis, as required by the Contractor's Authorization Basis Maintenance Procedure (24590-WTP-GPP-SREG-002, Rev. 5) was not prepared. Instead the Contractor continued with development of specifications and issued MRs for bids based on the nonconforming standards. QAM Policy Q-16.1 required that "services and processes that do not meet established requirements are to be identified…, documented, controlled, and corrected…" Because the Contractor did not follow their procedures and issue a CAR and DTD, this was a considered another example of the Finding for failing to meet the contractual requirement to implement the DOE-approved QAM (IR-03-016-04-FIN).

1.3.3 Conclusions

The inspectors concluded that the Contractor had properly implemented the majority of the mechanical design and analysis codes and standards stipulated in the SRD. However, for piping, pipe supports and pump pressure casings, the Contractor used design code and standards that were not identified in the SRD SC. This resulted in two examples of a Finding for failure to meet contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN). Additionally, although Contractor staff and management were aware of the non-compliance, the Contractor failed to take appropriate corrective actions to address the use of unapproved codes and standards. This resulted in two examples of a Finding for failure to meet contractual requirements to implement the DOE-approved QAM (IR-03-016-04-FIN).

1.4 Implementation of SRD Control, Electrical, Instrumentation, and Human Factors Design Standards (ITP I-110)

1.4.1 Inspection Scope

This part of the inspection was to verify, by interviewing responsible personnel and reviewing selected design documents, the Contractor was implementing SRD codes and standards for the design of ITS control, instrumentation, and electrical systems and components as specified in SRD SC 4.1-3, 4.3, and 4.4. The inspectors tailored the inspection scope to be consistent with the preliminary status of the design in this area and the limited number of ITS design documents issued by the Contractor as final (numerical) revisions. The verification was to ensure the following:

- Design requirements for the ITS electrical power distribution system were in accordance with IEEE-308-1991, *Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. (SRD SC 4.4-4)

- Electrical independence and separation requirements were in accordance with IEEE 384-92, *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits*. (SRD SC 4.3-2, 4.3-5, 4.4-4, 4.4-5)

- Battery sizing methodology requirements were in accordance with IEEE 485-1983, *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations.* (SRD SC 4.4-4)

- Raceway design requirements were in accordance with IEEE 628-1987, *Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations*, as tailored in SRD Appendix C. (SRD SC 4.4-4)

- Electrical protection requirements were in accordance with IEEE 741-1990, *Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*, as tailored in Appendix C. (SRD SC 4.4-4)

- The design requirements for the ITS DC power distribution system were in accordance with IEEE 946-1992, *Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations*. (SRD SC 4.4-4)

- The design requirements for electric power systems designated as Safety Design Significant (SDS) were in accordance with NFPA 70-1999, *National Electric Code*. (SRD SC 4.4-5)

- Seismic qualification requirements were in accordance with IEEE 344-1987, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*. (SRD SC 4.1-3 and 4.3-2)

- Instrumentation design requirements were in accordance with ISA S84.01-1996, *Application of Safety Instrumented Systems for the Process Industries,* (SRD SC 4.3-1)

1.4.2 Observations and Assessments

Control, Electrical, and Instrumentation Design Standards

For ITS systems and components, the Contractor had issued a single-line electrical diagram, an electrical design criteria and guide document, two electrical calculations, two electrical specifications, and three control and instrumentation specifications. The inspectors reviewed these documents as discussed below to assess if the Contractor had properly referenced and implemented the applicable SRD control, instrumentation, and electrical design standards.

SRD SC 4.4-4 required that an onsite and offsite electric power system be provided to permit functioning of systems designated as Safety Design Class (SDC). The safety function for each system (assuming the other system is not functioning) would be to provide sufficient capacity and capability to assure SDC functions are maintained in the event of postulated accidents. SRD

SC 4.4-4 also required the onsite power systems to include sufficient independence, redundancy, and testability to ensure that the safety function can be performed under postulated accident conditions, including a single failure if postulated. Physical and electrical separation shall be provided between diverse or redundant SDC electrical systems. SRD SC 4.4-4 required the Contractor to meet, in part, IEEE 308-1991, *Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*.

The inspectors reviewed 24590-BOF-E1-MVE-00001, Revision 1, *Overall Facilities Main Single Line Diagram*, which identified the ITS portion of the balance of facility (BOF) distribution system and emergency diesel generators. The diagram also showed the interface between onsite and offsite power, redundant emergency diesel generators (EDGs), and the distribution equipment for onsite power. The diagram did not provide details such as metering, detailed interlocks, and protective relaying, but it did describe a configuration consistent with the requirements of IEEE 308-1991 with respect to onsite and offsite sources, as well as independence, redundancy, and testability of the onsite sources. For example, a note on the diagram indicated the offsite source breaker and the EDG breaker would be interlocked such that only one breaker could be closed at a time, except when load testing the EDG while the sources are synchronized, or while restoring normal (preferred) power. The inspectors concluded the single line diagram configuration was consistent with the general requirements of IEEE 308-1991.

SRD SC 4.4-4 also required the Contractor to meet, in part, IEEE 485-1983, *Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations*; IEEE 628-1987, *Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations*, as tailored in SRD Appendix C; IEEE 741-1990, *Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*, as tailored in Appendix C; and IEEE 946-1992, *Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations*. In addition, the daughter standards referenced in these IEEE standards also applied to the design of ITS electrical power systems and components.

The ITS electrical distribution system design and procurement had not progressed to the point where the inspectors could review a detailed design against the specific methodology and requirements of these standards. Instead, the inspectors performed a general review of the codes and standards stipulated in 24590-WTP-DC-E-01-001, *Electrical Design Criteria and Guide,* Revision 0. The Contractor stated the design guide would be followed, so the inspectors reviewed this document to evaluate consistency with SRD implementing codes and standards.

The Electrical Design Criteria and Guide summarized the electrical design criteria for the WTP project. These requirements were detailed in the various source documents referenced in the document. The source documents referenced in the Electrical Design Criteria and Guide included implementing codes and standards listed for the SRD SC. The source documents included other codes and standards specified in Authorization Basis and contractual requirements, but the inspectors did not perform a detailed review of these codes and standards.

The inspectors found the Electrical Design Criteria and Guide generally consistent with SRD SC

requirements and implementing codes and standards. The document was generally comprehensive and provided traceability to appropriate SRD implementing codes and standards. Based on review of the document and interviews with the electrical design staff, the inspectors concluded the document could be useful to design engineers and designers in ensuring conformance of the control, instrumentation, and electrical design to the requirements of the SRD.

However, the inspectors identified three discrepancies in the Electrical Design Criteria and Guide that conflicted with the associated SRD SC implementing codes and standards, as discussed further below. The inspectors also identified an inconsistency with the General Information Volume of the Preliminary Safety Analysis Report (PSAR) for application of standards not governed by the SRD SC. The discrepancies were:

- The general site environmental conditions identified in the Electrical Design Criteria and Guide did not include ashfall. The capability of withstanding this natural phenomena hazard (NPH) was required by SRD SC 4.1-3 and would apply to the emergency diesel generators and outdoor ITS equipment.

- For sizing batteries that support ITS uninterruptible power systems (UPS), the Electrical Design Criteria and Guide stipulated IEEE Standard 1184, *Guide for Selection and Sizing of Batteries for Uninterruptible Power Systems*, rather than IEEE Standard 485-1983, which is required by SRD SC 4.4-4. IEEE Standard 1184 was not an SRD implementing code or standard. Moreover, IEEE Standard 1184 was primarily intended for use in selecting among battery technologies, and only provided an overview of battery sizing methodology, rather than the explicit calculation procedures stipulated by IEEE Standard 485.

- Section 16.2 of the Electrical Design Criteria and Guide included qualitative requirements for surge protection of electrical and electronic equipment; however, no surge protection standards were identified in the document. The implementing standards for SRD SC 4.4-4 included IEEE Standard 741-1990, *Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*, which cited the daughter surge protection standards IEEE C37.96-1988, *IEEE Guide for Motor Protection*; IEEE C62.2-1987, *IEEE Guide for Application of Gapped Silicon Carbide Surge Arrestors for Alternating-Current Systems*; IEEE C62.41-1980, *IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits*; and IEEE C62.45-1987, *IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits*.

The electrical design documents that could potentially be affected by the SRD implementing codes and standards conformance issues discussed above were still preliminary, with work in progress, and no procurements of ITS electrical hardware had been placed that could have been affected by the discrepancies. During the inspection, the Contractor identified to the inspectors their intention to address these discrepancies in a forthcoming Revision 1 to the Electrical Design Criteria and Guide. Given the advisory nature of the Guide, the inspectors did not consider these discrepancies as sufficient bases for a Finding. However, based on similar issues with SRD compliance that resulted in Finding IR-03-016-03-FIN, the inspectors expressed to BNI

management their concern that use of the Guide could result in additional deviations from the Authorization Basis. In that regard, correction of these discrepancies will be tracked as IR-03-016-02-AFI. Because an exhaustive review of the document was not performed, the inspectors recommended that the Contractor perform a more extensive review of the Electrical Design Criteria and Guide for SRD SC implementing codes and standards compliance.

SRD SC 4.4-5 required, in part, that electric power systems designated as SDS shall be designed to ensure their operability under normal conditions. Implementing codes and standards for SRD SC 4.4-5 included NFPA 70-1999, *National Electric Code*.

The inspectors reviewed the following electrical calculations to determine if the Contractor used NFPA 70-1999 as a basis for determining cable ampacity for selected configurations. The inspectors did not review the calculations in their entirety or in depth.

- 24590-WTP-E1C-LVE-00001, Revision 0, *Cable Ampacity Limitations*

- 24590-WTP-E1C-MVE-00002, Revision 0, *Medium Voltage Feeder Cable Sizing and UG Derating*

Calculation 24590-WTP-E1C-LVE-00001 determined cable ampacity limitations for 600V cables for underground ducts and embedded conduits, as well as 15kV, 5kV, and 600V power cables in open top cable trays and exposed conduits. Based on limited review of the calculations, the inspectors found the Contractor was using ampacity values based on NFPA 70-1999, Articles 310, 318 and 346, with correction for ambient temperature, installation configuration, soil thermal resistivity, and depth of burial. For ITS 5kV power cables, Section 7.2 of calculation 24590-WTP-E1C-MVE-00002 referenced calculation 24590-WTP-E1C-LVE-00001. Since the inspectors concluded calculation 24590-WTP-E1C-LVE-00001 adequately implemented NFPA 70-1999, no further review of calculation 24590-WTP-E1C-MVE-00002 was performed.

Based on these selective reviews, the inspectors determined that the Contractor was using NFPA 70-1999 as a design basis for the calculations, consistent with SRD SC 4.4-5.

SRD SC 4.1-3 addressed the natural phenomena hazards (NPH) design for structures, systems, and components (SSC) that were ITS and had NPH safety functions. IEEE 344-1987 was the standard invoked by SRD SC 4.1-3 for the requirements necessary to implement the SC. The inspectors reviewed the following electrical, instrumentation, and control equipment engineering specifications for compliance with the SRD SC 4.1-3 implementing codes and standards:

- 24590-WTP-3PS-MUMI-T0002, Revision 1, *Engineering Specification for Low Voltage Induction Motors*

- 24590-WTP-3PS-MUMI-T0001, Revision 1, *Engineering Specification for Medium Voltage Induction Motors*

- 24590-WTP-3PS-JD03-T0002, Revision 0*, Engineering Specification for Programmable Protection System*

- 24590-WTP-3PS-JXXE-T0002, Revision 1, *Engineering Specification for C&I Enclosures, Panels, Cabinets, and Racks*

- 24590-WTP-3PS-J000-T0001, Revision 1, *Melter Systems C&I Work Specification*

The inspectors did not identify any deviations to the requirements of IEEE 344-1987 for NPH protection. For SDC or SDS applications, IEEE 344-1987 was either referenced directly in the general specification, or indirectly referenced via 24590-WTP-3PS-JQ06-T0003, *Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components*.

The inspectors closed inspector follow-up item IR-02-012-02-IFI from the previous Standards Implementation Inspection. In reviewing Design Guide 24590-WTP-GPG-J-015, *Design Guide for Safety Instrumented Systems Implementation*, Revision A, the previous inspectors questioned whether the programmable protection system complied with single failure criteria with respect to common cause failures resulting from software errors. Those inspectors determined there were no requirements in the available documents to consider or protect against software common-mode failures for protection of the most critical safety functions, as required by SRD SC 4.3-3.

Based on review of applicable portions of Revision B to the Design Guide for Safety Instrumented Systems Implementation during this inspection, the inspectors concluded that this IFI could be closed. Section 3 of the Revision B design guide identified generic software safety requirements applicable during common cause analysis at the conceptual design stage, including software design analysis techniques appropriate to common cause failure or timing concerns (such as Petri net or software fault tree analysis). Appendix K of the design guide, Section 3, "Software Common Cause Failure," stipulated that application software common cause failure was addressed through the use of a software life cycle, fault tree analysis in the design phase of the software life cycle, and exhaustive application logic verification testing. The inspectors determined the Revision B design guide changes addressed the question from the previous inspection, and effective use of these methods should provide reasonable assurance that common cause failures resulting from software errors would be precluded. Therefore, inspection follow-up item IR-02-012-02-IFI is considered closed.

Human Factors Design Standards

Because of continuing Contractor efforts to respond to a previous inspection Finding, the inspectors did not review the Contractor's Human Factors program or documentation as part of this inspection. During the previous SRD Design Standards Implementation Inspection, the inspection team identified Finding IR 02-012-03-FIN for failure to establish a process that incorporated HFE in the facility design. Specifically, there was no documented evidence the Contractor had established a process that incorporated HFE in the facility design (e.g., documentation demonstrating implementation of IEEE 1023, Section 6.1, Task Analysis, was not

found). The Contractor's first response to the finding was unacceptable[2]. The Contractor submitted an amended response, which provided five commitments[3] and was subsequently accepted by ORP[4]. The amended response contained a conceptual approach; the details of the commitments were not evaluated by ORP for technical adequacy since the commitments were not yet complete. One of the commitments was to issue the HFE Program Implementation Plan by June 28, 2003 [24590-WTP-PL-G-03-002, Rev. 0, "Human Factors Program Implementation Plan for Design and Commissioning," (Plan)].

The Contractor issued the HFE Program Implementation Plan on May 12, 2003, and notified the ORP of its availability for review. The inspectors (from the previous inspection) reviewed the Plan and determined that, in some instances, the Plan did not meet the Contractor's commitments in the revised inspection Finding response, the SRD or the implementing standard (IEEE 1023). The Plan's inadequacies are listed below.

1) One of the Contractor's commitments (i.e., item 1 from the Contractor's Supplemental Response) to the Finding was to systematically apply IEEE 1023-1988 to the WTP facility design and apply the HFE process described in subsection 6.1.1 of IEEE 1023-1988 to the design of the systems employed to mitigate SL-1 and SL-2 hazards and all ITS SSCs. (Emphasis added.)

   Contrary to the above commitment, Section 5.6 of the Plan only addressed the SL-1 and SL-2 accident sequences and did not complete the "and all ITS SSCs" portion of the commitment as included in the supplemental response.

2) IEEE 1023-1988, Section 6.1.1.6 stated the following:

   "Equipment Requirements. Controls, display, and communication equipment requirements necessary to perform each task should be determined, based on the task analysis."

   Contrary to the above, the HFE Program Implementation Plan, Section 5.9, Equipment Selection, stated "Project design guides are used to specify human-machine interfaces in order to ensure reliable human performance." The Plan should be revised to properly reflect the equipment selection process required by the IEEE Standard.

3) HFE Program Implementation Plan, Section 7.3, Simulation. This section provided a detailed description of the simulator and mockup of the WTP facility, but no tie to the performance of design Task Analysis, in accordance with Section 6.1.1.5 of IEEE 1023-

[2] ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Response to Findings of Safety Requirements Document Design Standards Implementation Inspection Report, IR-02-012," 03-OSR-0008, January 15, 2003.
[3] BNI letter from R. F. Naventi to R. J. Schepens, ORP, "Bechtel National, Inc.'s Supplemental Response to Inspection Report IR-02-012-Safety Requirements Document Design Standards Implementation," CCN-052350, February 27, 2003.
[4] ORP letter from R. J. Schepens to R. F. Naventi, BNI, "Acceptance of Bechtel National, Inc. (BNI) Responses to Safety Requirements Document Design Standards Implementation Inspection Report, IR-02-012, Findings, " 03-OSR-0131, dated March 28, 2003.

1988. Also, Section 7.3 of the Plan did not agree with SRD, Volume II, Rev. 2b, Section 2.6.2, which indicated the WTP project does not plan on constructing a separate plant simulator or physical mockup.

The inspectors (from the previous inspection) did not evaluate the adequacy of the Plan's commitments, since they were not complete at the time of this review. Therefore, this inspection Finding could not be closed at this time.

1.4.3 Conclusions

The electrical, control, and instrumentation design was almost entirely in preliminary status, with work in progress. Therefore, the inspectors' conclusions were based on a small number of ITS design documents that the Contractor had issued as final (i.e., numerical) revisions. Moreover, the scope of the available electrical, control, and instrumentation design documents did not reflect most of the detailed design attributes imposed by the SRD SC implementing codes and standards.

Based on interviews performed, the inspectors concluded that Contractor personnel had a good understanding of the safety significance of the IEEE and ISA implementing codes and standards identified for the SRD SC. Personnel who were not intimately familiar with a particular code or standard knew whom to contact within their organization for assistance in application or interpretation of the code or standard, and expressed their opinion that such a person was available for this assistance.

Except for the Electrical Design Criteria and Guide, the inspectors did not identify any discrepancies in the design documents. As discussed above, Contractor personnel stated their intention to address discrepancies to the Electrical Design Criteria and Guide in a forthcoming revision. Because of continuing problems with Contractor compliance with SRD implementing codes and standards, as discussed elsewhere in this report, correction of these discrepancies will be tracked as IR-03-016-02-AFI. In addition, the inspectors recommended that the Contractor perform further review of the Electrical Design Criteria and Guide for SRD SC implementing codes and standards compliance prior to the next revision.

As a result of the above inadequacies in the HFE Program Implementation Plan discussed in Section 1.4.3 above, and the other four open response commitments, the inspectors (from the previous inspection) could not close Finding IR 02-012-03-FIN at this time.

1.5 Implementation of SRD Mechanical (Ventilation) Design Standards (ITP-110)

1.5.1 Inspection Scope

This part of the inspection was to assess, by interviewing personnel and reviewing selected design documents, the implementation of SRD implementing codes and standards in the design of mechanical (ventilation) SSCs. The inspectors selected the High Level Waste (HLW) C5 ventilation system ducts, HEPA filters, and exhaust fans for this inspection.

1.5.2 Observations and Assessments

Revision 4 of ITP I-110, *Safety Requirements Document Design Standards Implementation Assessment*, was issued on May 30, 2003. On June 25, 2003, a new revision of the SRD (Rev. 2h) was issued. SRD Revision 2h changed SC 4.4-6 requirements for WTP air treatment systems. This portion of the inspection was conducted based on the SRD Revision 2g requirements for WTP air treatment systems in effect at the time Revision 4 to ITP I-110 was issued. ITP I-110, Revision 4 referenced ASME N509-1989 for many of the detailed design and material compliance requirements, instead of ASME AG-1-97.

SRD SC 4.4-6 required each air treatment system designated as SDC to be designed to ensure its operability under normal and accident conditions. It identified ASME N509-89, *Nuclear Power Plant Air-Cleaning Units and Components,* ASME AG-1-97, *Code on Nuclear Air and Gas Treatment,* and ASME N510-89, *Testing of Nuclear Air Treatment Systems*, as the implementing codes and standards for the design of SDC air treatment systems. These implementing codes and standards provided requirements for determining the allowable stresses, materials selection, and construction of SDC air treatment components.

The inspectors reviewed Engineering Specifications 24590-WTP-3PS-MDRM-T0001, Rev. 1, *Heating, Ventilation and Air Conditioning System Seismic Category I and II Ductwork;* 24590-WTP-3PS-MDH0-T0001, Rev. 1, *Heating, Ventilation and Air Conditioning System Category III and IV Ductwork;* and, 24590-WTP-3PS-MD00-T0001, Rev. 2, *Heating, Ventilation and Air Conditioning System Installation*, and determined the requirements for design, construction, testing, and installation of the HLW C5 ventilation ductwork met the requirements of ASME AG-1-97, Section SA.

The inspectors reviewed Engineering Specification 24590-WTP-3PS-MACS-T0001, Rev. 2, *High Integrity Centrifugal Fans,* issued by the Contractor for the design, materials of construction, fabrication and testing requirements of the HLW C5 ventilation system exhaust fans. The inspectors determined that Engineering Specification 24590-WTP-3PS-MACS-T0001, Rev. 2, met the requirements of SRD SC 4.4-6.

The inspectors reviewed Engineering Specification for the HEPA filters (24590-WTP-3PS-MKH0-T0002, Rev. 0, *Engineering Specification for HEPA Filters*) to determine how SRD SC 4.4-6 requirements were implemented. The inspectors determined that Engineering Specification 24590-WTP-3PS-MNH0-T0002, Rev. 0 met the requirements of SRD SC 4.4-6.

1.5.3 Conclusions

Based on review of Engineering Specifications for the HLW C5 ventilation system, the inspectors concluded the Contractor had adequately incorporated the requirements of SRD SC 4.4-6 implementing codes and standards into the design of HLW C5 ventilation ducting, fans, and HEPA filters.

1.6 Implementation of SRD Fire Protection Design Standards (ITP-110)

1.6.1 Inspection Scope

The inspectors reviewed specifications, calculations, and drawings for fire protection SSCs and interviewed Contractor safety, engineering, and architectural personnel to assess:

- Implementation of the codes and standards required by the SRD Section 4.5 SC in the design of WTP fire protection SSCs.

- Implementation of National Fire Protection Association (NFPA) Standard 801-1995, Section 3.5 requirements for fire resistant or noncombustible design of buildings in which radioactive and/or hazardous materials are used, handled, or stored. (SRD SC 4.5-2)

- Implementation of American Society for Testing and Materials (ASTM) Standard E814 requirements for fire barrier penetration seals, as required by NFPA 801-1995, Section 3-6.3. (SRD SC 4.5-3)

- Implementation of NFPA 801-1995, Section 3-10.2.1 requirements for the building floor drainage systems in radioactive material handling areas. (SRD SC 4.5-3)

- Implementation of NFPA 801-1995, Section 4-8.3 requirements for fire detection and alarm systems. (SRD SC 4.5-7)

1.6.2 Observations and Assessments

<u>Assessment for Implementation of SRD Section 4.5 Implementing Codes and Standards in the Design of WTP Fire Protection Structures, Systems, and Components</u>

The inspectors reviewed the engineering specifications and calculation identified below to assess the implementation of SRD Section 4.5 implementing codes and standards.

- Engineering Specification No. 24590-WTP-3PS-PZ41-T0003, Wet Pipe Automatic Fire Suppression Systems and Stand Pipes, Revision 1, dated March 18, 2003

- Engineering Specification No. 24590-WTP-3PS-MTF5-T0001, Field-Erected Tanks Design and Fabrication, Revision 0, dated December 3, 2002

- Engineering Specification No. 24590-WTP-3PS-PZ41-T0001, Preaction Fire Suppression Systems, Revision 1, dated March 18, 2003

- Engineering Specification No. 24590-WTP-3PS-PZ41-T0002, Dry Pipe Fire Suppression Systems, Revision 1, dated March 18, 2003

- Performance Specification No. 24590-BOF-3PS-G000-T0003, BOF Pumphouse Facilities, Revision 0, dated December 3, 2002

- Calculation No. 24590-BOF-MTF-FSW-00001, BOF Fire Water Storage Tank Sizing, Revision 0a, dated January 13, 2003

The inspectors determined these documents reflected code editions for daughter standards of SRD implementing codes and standards based on the assumed ORP approval of Authorization Basis Amendment Request (ABAR) 24590-WTP-ABAR-ENS-02-014, Revision 1, "Adoption of NFPA 801-2003 and Removal of Fire Protection Tailoring from the Safety Requirements Document." The Contractor had self-identified this condition as being discrepant with the project Authorization Basis and had issued CAR 24590-WTP-CAR-QA-03-083. The CAR corrective actions were tied to ORP approval of the ABAR. Since the Contractor had already identified the discrepant condition and prepared the necessary quality assurance documentation to ensure actions were taken to disposition the condition, the inspectors had no findings in this area.

Assessment for Noncombustible or Fire-Resistant Design of the RPP-WTP Process Buildings

SRD Safety Criterion 4.5-2 required buildings containing a significant quantity of radioactive and/or hazardous material to be constructed (walls, floors, and ceilings) of noncombustible or fire-resistive material. An implementing standard identified for this SC was NFPA 801, *Standard for Facilities Handling Radioactive Materials, 1995 Edition*. The inspectors reviewed Contractor documentation to assess the noncombustible or fire-resistant construction of the RPP-WTP process buildings, including fire area boundaries.

- NFPA 801-1995, Section 3-5 required buildings in which radioactive materials would be used, handled, or stored to be fire resistive or noncombustible (Type I or Type II in accordance with NFPA 220*, Standard on Types of Building Construction*). **Note:** During the course of the inspection, ORP approved (03-OSR-0264, dated July 22, 2003) an update to the SRD (ABAR 24590-WTP-ABAR-ENS-02-014, Revision 1) that replaced NFPA 801-1995 with NFPA 801-2003 as an implementing code and standard for SRD Section 4.5 SC. The inspectors confirmed NFPA 801-2003, Section 5.5, *Construction*, contained the same requirement as in Section 3-4 of NFPA 801-1995.

- The inspectors verified that DOE letter 02-OSR-0382 approved ABCN 24590-WTP-ABCN-ESH-02-012*, Types of Building Construction – Fire Resistance Rating,* to tailor NFPA 801-95, Section 3-5 and replace "Type I or Type II in accordance with NFPA-220, *Standard on Types of Building Construction"* with "Fire resistance in accordance with the 1997 edition of the Uniform Building Code (UBC-97)." The inspectors further verified that DOE letter 03-OSR-0145 approved ABCN 24590-WTP-ABCN-ESH-02-033, *Applications of IBC 2000 for Determination of Classification of Construction Type for the RPP-WTP Process Facilities*, that replaced the non-structural chapters from UBC-97 with the corresponding chapters from the International Building Code (IBC), 2000 Edition. The inspectors determined that, based on this approval, the construction types

and requirements for the WTP process buildings were based on IBC, 2000 requirements as opposed to those from either the UBC-97 or NFPA 220.

- The inspectors reviewed the HLW Preliminary Fire Hazards Analysis (PFHA, 24590-HLW-RPT-ESH-01-001) and determined the PFHA subdivided the HLW building into fire areas separated by 2-hour rated fire barriers. The inspectors further confirmed the construction type classification for the HLW building to be Type I-FR (fire resistive) in accordance with UBC-97 requirements. The classification of the HLW building construction type per the requirements of the IBC, 2000 was pending at the time of the inspection, but the preliminary classification was Type II-B. Per IBC, 2000, Section 602.2, this type of construction involved building elements constructed of noncombustible materials.

- Based on further review of the HLW PFHA, the inspectors determined the HLW building structure, including, fire barriers, were constructed of reinforced concrete and structural steel or other fire-rated materials, including rated fire doors, fire dampers, and penetration seals. As such, the inspectors concluded the design of WTP process buildings was implementing the NFPA 801-1995 requirement for fire resistant or noncombustible construction.

Assessment of the Implementation of ASTM E814 Requirements for Fire Barrier Penetration Seals

SRD SC 4.5-3 required confinement of the fire to its origin to be achieved by passive barriers and by activating systems such as fire and smoke dampers, exhaust fans, and drainage pumps to prevent migration of gases, hot combustion products, and flammable liquids outside the fire area. An implementing standard identified for this SC was ASTM E814, *Fire Tests of Through-Penetration Fire Stops*. To assess implementation of the requirements of ASTM E814, the inspectors reviewed an Engineering Specification and interviewed Contractor fire protection engineering and architectural personnel to assess the implementation of ASTM E814 requirements for fire barrier penetration seals.

- The inspectors identified that Section 3-6.1 and Appendix A, Section A-3-6.1 of NFPA 801-1995 required penetration seals for electrical and mechanical openings to meet the requirements of ASTM E 814 or Underwriter Laboratories (UL) 1479*, Fire Tests of Through-Penetration Fire Stops*.

- The inspectors interviewed the Fire Protection Engineering Supervisor, the Deputy Architectural Lead, and the Architect assigned responsibility for the design of fire barrier penetration seals. Contractor personnel were aware of and stated their intention to meet the SRD and implementing code requirements for fire barrier penetration seals.

- Inspectors reviewed Engineering Specification 24590-WTP-3PS-ATFS-T0001, *Engineering Specification for Through-Penetration Firestop System, 07841*, Revision 0, dated June 18, 2003. The inspectors confirmed that the Performance Requirements (Section 1.3), Quality Assurance requirements (Section 1.4), and Referenced Standards

(Section 1.2) required compliance with the requirements of ASTM E 814. Although the Engineering Specification addressed the correct standard (i.e., ASTM E 814) for the fire testing of penetration seals for electrical and mechanical openings, the code edition called out by Section 1.2 of the Engineering Specification (2000 Edition) was not consistent with the requirements of NFPA 801-1995, that referenced the 1994 Edition of ASTM E 814. This was another example of inconsistent application of daughter standards of the SRD implementing codes and standards as addressed by CAR 24590-WTP-CAR-QA-03-103. Because the Contractor had self-identified the problem with the inconsistent application of SRD daughter standards, including the issuance of CAR 24590-WTP-CAR-QA-03-103 and its associated corrective actions, this concern was not identified as a Finding in this Inspection Report. The inspectors concluded this specific instance should be corrected as part of the overall corrective actions associated with CAR 24590-WTP-CAR-QA-03-103. The resolution of this discrepancy will be tracked as with IR-03-016-01-AFI.

Assessment of the Implementation of NFPA 801 Requirements for WTP Process Building Drainage Systems

SRD SC 4.5-3 required confinement of the fire to its origin to be achieved by passive barriers and by activating systems such as fire and smoke dampers, exhaust fans, and drainage pumps to prevent migration of gases, hot combustion products, and flammable liquids outside the fire area. An implementing standard identified for this SC was NFPA 801-1995. Section 3-10.2 of NFPA 801-1995 (Section 5.10.2 of NFPA 801-2003) required provisions for drainage design in areas handling radioactive materials and in any associated drainage facilities (e.g., pits, sumps, and sump pumps) to be sized to the following criteria:

- The credible volume of discharge (as determined by the fire hazards analysis) for the suppression system operating for a period of 30 minutes where automatic suppression is provided throughout.

- The volume based on a manual fire-fighting flow rate of 500 gpm for a duration of 30 minutes where automatic suppression is not provided throughout, unless the fire hazards analysis demonstrates a different flow rate and duration.

- The contents of piping systems and containers that are subject to failure in a fire where automatic suppression is not provided throughout.

To assess implementation of the NFPA 801-1995 requirements for building drain systems, the inspectors interviewed fire protection engineering and mechanical systems management and design personnel and reviewed the following engineering calculations:

- Calculation No. 24590-PTF-M6C-PWD-00065, PT Building C2/C3 Fire Water Floor Drain Sizing, Revision A, dated June 16, 2003

- Calculation No. 24590-HLW-M6C-RLD-00015, HLW Gravity Flow Line Sizing, Revision A, dated October 25, 2002

- Calculation No. 24590-HLW-M6C-RLD-00005, HLW Plant Wash and Drains Vessel RLD-VSL-00008, Revision B, dated September 4, 2002

- Calculation No. 24590-HLW-M6C-NLD-00005, Pump and Line Sizing for NLD System, Revision C, dated August 24, 2002

- Calculation No. 24590-HLW-M6C-NLD-00002, C2 Drains Collection Tank, Revision D, dated April 16, 2003

- Calculation No. 24590-HLW-M6C-NLD-00003, Non-Radioactive Floor Drains Collection System, Revision B, dated August 15, 2002

- Calculation No. 24590-LAW-M6C-20-00001, RLD and NLD Floor Drain Sizing, Revision B, dated June 11, 2003

- Calculation No. 24590-LAW-M6C-NLD-00001, C1/C2 Drains Sump Collection Tank, Revision 0, dated December 18, 2001

- Calculation No. 24590-LAW-MTC-520-00001, Sizing of the LAW C1/C2 Drain Collection Tank (T25032), Revision 0, dated July 18, 2001

- Based on the interviews and review of the above calculations, the inspectors determined the Pretreatment floor drain system for C2/C3 areas was designed to accommodate a sprinkler discharge of 0.17 gallons per minute per square foot (gpm/ft.^{2}) over the most remote 3,000 ft.^{2}, which included the hose stream allowance.

    - The time for fire water discharge was not important to the Pretreatment design basis, since the system was being designed to accommodate the limiting fire water discharge without experiencing slug floor in the drain headers. The inspectors concluded this design basis was consistent with the first criteria identified above.

    - The approach used in the design of the Pretreatment building C2/C3 Area Water Floor Drain Collection System was to size the drain fixtures and pipes so open channel flow was maintained in the branches and vessels. Open channel flow was needed to maintain an air gap in the upper portion of the pipe to prevent slug flow that restricts normal flow. The Contractor's analysis indicated the Pretreatment C2/C3 Area Water Floor Drain Collection System design (stacks, stack vents, branch lines, headers, and drain screens) was capable of draining the worst case fire water discharge without experiencing slug flow and the bounding floor loading [less than 10 pounds mass per square foot (lbm/ft.^{2})] created by the discharged fire water was well within the preliminary design basis for the floor live load (100 lbm/ft.^{2}). The inspectors found the design of the Pretreatment C2/C3 Area Water Floor Drain Collection System acceptable and compliant with SRD implementing codes and standards.

- The inspectors identified that Pretreatment Calculation 24590-PTF-M6C-PWD-00065 did not address C5 areas within the facility. Per discussions with the Fire Protection Engineering Supervisor, it was identified that the Pretreatment drain system design was based on anticipated approval by ORP of the Contractor's request for omission of fire suppression systems from Pretreatment C5 areas. This design assumption was recognized by ORP during review of the Preliminary Safety Analysis Reports in support of the Construction Authorization Requests. A condition of approval stipulated by ORP for Pretreatment construction authorization was to not construct any portion of the facility without the ability to install a fire suppression system. The Contractor has complied with the condition of approval pending final approval of the request to omit sprinklers from building areas. This was acceptable to the inspectors.

- Based on the interviews and review of calculations identified above, the inspectors determined the Low Activity Waste (LAW) building floor drain systems for C1/C2 (System NLD) and C3/C5 (System RLD) areas were designed to accommodate a sprinkler discharge of 0.17 gpm/ft.^{2} over the most remote 3,000 ft.^{2}, for a 30 minute duration. This included the hose stream allowance for manual fire fighting.

  - Although the NLD and RLD floor drain systems were not designed to fully accommodate the worst-case fire water discharge, the Contractor analyzed the build-up of water in building areas and the resulting floor loads. For worst-case sprinkler discharges over a 30 minute period, Contractor Calculation 24590-LAW-M6C-20-00001 indicated floor loadings of 10.3 lbm/ft.^{2} (NLD) and 3.2 lbm/ft.^{2} (RLD); both within the allowable floor loading of 100 lbm/ft^2. However, since the sprinklers could operate for 2 hours (assuming the unlikely lack of intervention by the Hanford Fire Department to shutdown the sprinkler system), the inspectors were concerned that the floor loadings could be higher, although still within the allowable floor load. Per discussions with the Fire Protection Engineering Supervisor, it was identified that the 3,000 ft.^{2} discussed above was very conservative. Most fires (> 90%) are suppressed by the actuation of five or less sprinkler heads. This would certainly be the expectation for LAW as well, given the low combustibles loadings throughout the facility. The 3,000 ft^2 requirement for the area involved in the limiting fire event equated to the actuation of approximately 25 sprinkler heads. Based on this, the inspectors concluded the design of the LAW drain system satisfied the requirements of SRD SC 4.5-3 implementing design standard NPFA 801-1995, Section 3-10.2.

- Based on the interviews and review of calculations identified above, the inspectors determined that HLW building floor drains for C2/R2 (NLD system) areas were designed to accommodate a conservative sprinkler discharge of 0.2 gpm/ft^2 over the most remote 3,000 ft.^{2}, with a waste factor (over-capacity) of 0.4.

  - Based on review of Calculation 24590-LAW-M6C-20-00001, the inspectors found the 6 inch drain pipe and 8 inch header pipe used in the NLD system adequate to accommodate the limiting sprinkler water discharge. Fire water would drain to

the C2 Drains Collection Tank (NLD-TK-00006) which had a 1500 gallon capacity. For the limiting and unexpected fire water discharge, the excess fire water would overflow the tank and collect in the fire water collection area, room HB308 at the -31 ft. elevation. The inspectors concluded the design of the LAW drain system satisfied the requirements of SRD SC 4.5-3 implementing design standard NPFA 801-1995, Section 3-10.2.

- For the HLW building floor drains for C3 and C3/R5 (RLD system) areas, the calculations reviewed by the inspectors did not appear to account for fire water from the actuation of sprinklers. Based on interviews with Contractor Mechanical Systems design personnel and supervision, it was identified that the HLW RLD system design was not complete. This was supported by the calculations reviewed by the inspectors that were both alpha revision documents. The Contractor stated that if the decision was made to allow fire water to accumulate in a C3 or C3/R5 area, the flooding evaluation being performed in response to HLW Construction Authorization Request condition of approvals (per Safety Evaluation Report sections 4.2.2.2, item 2[a]) would address any related structural or flooding impacts. This was acceptable to the inspectors.

Assessment of Implementation of NFPA 801-1995 Requirements for Fire Detection and Alarm Systems

SRD SC 4.5-7 required the facility to include a fire detection system to detect the presence of a fire and activate alarm systems so measures for confinement and suppression of the fire and personnel evacuation could start promptly. The detection system must include a means to summon the Hanford Site fire department and be capable of operation without offsite power. An implementing standard identified for this SC was NFPA 801-1995. Section 4-8 of NFPA 801-1995 (Section 6.8 of NFPA 801-2003) specified design requirements for the "Fire Signaling Systems" (Fire Alarm Systems) and required the use of NFPA 72*, National Fire Alarm Code,* for the installation of the fixed fire suppression and alarm systems.

To assess implementation of the NFPA 801-1995 and NFPA 72 requirements for fire detection systems, the inspectors reviewed Engineering Specification 24590-WTP-3PS-JQ05-T0001*, Engineering Specification for Fire Detection and Alarms Systems*, Revision 1, dated October 16, 2002.

- The inspectors determined that the specification required a fire detection and alarms system meeting the requirements of NFPA 72, 2002 Edition and NFPA 801-1995, Section 4-8 (NFPA 801-2003, Section 6.8). However, the inspectors identified that the code editions of daughter standards called out in the specification were not consistent with the code editions called out by the implementing codes and standards of SRD SC 4.5-7. This inconsistency was resolved by DOE approval of ABAR 24590-WTP-ABAR-ENS-02-014, as discussed previously. In the interim, the Contractor generated CAR 24590-WTP-CAR-QA-03-083, dated March 26, 2003, identifying the issue with the code editions in effect for daughter standards referenced in SRD Section 4.5 SC implementing codes and standards. The CAR identified the changes proposed by ABAR 24590-WTP-

ABAR-ENS-02-014, Revision 1 as the actions necessary to resolve the CAR condition. The inspectors found this to be acceptable and would result in the design of WTP fire detection and alarm systems satisfying the requirements of the SRD SC 4.5-7 implementing design codes and standards.

1.6.3 Conclusions

Contractor personnel were adequately knowledgeable of SRD Section 4.5 SC and implementing codes and standards requirements for the design and construction of WTP fire protection SSCs. Design documentation for WTP building fire barriers, fire barrier penetration seals, fire detection and alarm systems, fire suppression sprinkler systems, and building floor drainage systems was generally acceptable and compliant with SRD implementing codes and standards. The issue with the use of code editions for daughter standards referenced in SRD Section 4.5 SC implementing codes and standards that were not consistent with the approved authorization basis had been identified by the Contractor and documented in a CAR. The design of WTP building drain systems was progressing in accordance with conditions of approval documented in the Safety Evaluation Reports for the Construction Authorization Requests.

1.7 Deviations From Implementation of the Design Standards

1.7.1 Inspection Scope

The inspectors interviewed Contractor personnel and reviewed documents to determine whether the Contractor staff was knowledgeable of the Contract requirements for processing changes to the project Authorization Basis (i.e., RL/REG-97-13, Revision 9), the requirements of SRD implementing design codes and standards, and the process for correcting deviations to SRD implementing codes and standards.

1.7.2 Observations and Assessments

The inspectors determined during interviews the Contractor engineering and design personnel and supervision were knowledgeable of the Contract and Authorization Basis requirements. Although there were identified examples of weaknesses in the process, as discussed below, interviewees were otherwise familiar with the process that must be followed if a desired standard was different from the implementing codes and standards, including daughter standards, identified in the SRD. Evidence this process is working was reflected in DTDs, ABCNs, and ABARs submitted to the ORP since the time of the last SRD Design Standards Implementation Inspection.

However, in the mechanical design and analysis area, the inspectors identified instances where the Contractor failed to process required project documentation (e.g., CARs, DTDs, etc.) after identifying design activities discrepant from the project Authorization Basis. Specifically, for piping, pipe supports, and pump pressure casings, the Contractor used design codes and standards not listed as implementing codes and standards in the SRD. This resulted in a Finding for failure to meet Contractual requirements to implement the DOE-approved SRD (IR-03-016-03-FIN). Additionally, the contractor failed to

initiate CARs to address the use of unauthorized code and standards, although Contractor staff and management were aware of the non-compliance. This resulted in a Finding for failure to meet Contractual requirements to implement the DOE-approved QAM (IR-03-016-04-FIN).

1.7.3 Conclusions

Although specific instances of a breakdown in the process were identifies, the inspectors concluded that Contractor personnel were knowledgeable of Contract design requirements and SRD implementing codes and standards and the process required to change them. The inspectors attributed the breakdowns in the process to poor understanding of the requirements of particular implementing codes and standards and a procedural requirement, since revised, that allowed a CAR to be closed on the basis of issuance of ABARs, as opposed to ORP approval of the ABARs.

2.0 EXIT MEETING SUMMARY

The inspectors presented the inspection results to members of Contractor management at an exit meeting on July 25, 2003. The Contractor acknowledged the findings and observations presented. The inspectors asked the Contractor whether any materials examined during the inspection should be considered limited rights data. The Contractor stated that no limited rights data was examined during the inspection.

3.0 REPORT BACKGROUND INFORMATION

3.1 Partial List of Persons Contacted

S.Anderson, Discipline Engineering Manager, C&I
G. Aiyer, Seismic Analysis Coordinator (Lead), Civil/Structural/Architectural
B. Bitner, Deputy Discipline Manager, Civil/Structural/Architectural
M. Braccia, Area Discipline Supervisor, Civil/Structural/Architectural
B. Cheung, Area Discipline Supervisor, Electrical
T. DeGarmo, Fire Hazard Analysis Eng. Lead, E&NS
D. Dickehuth, Sr. Engineer, C&I
G. Duncan, Discipline Engineering Manager, Mechanical & Process
E. Eddrief, Area Discipline Supervisor, Electrical
G. Carcia, Systems Lead, HVAC & Fire Protection
J. Forrest, Sr. Engineer, C&I
K. Gupta, Structural Supervisor, Civil/Structural/Architectural
M. Hall, Sr. Engineer, Melter Systems
B. Harshberger, Specialist Codes (Sr. Engineer), Electrical
E. Hardwick, Sr. Engineer, Electrical
K. Herman, Area Discipline Supervisor, C&I
D. Houghton, Structural Engineer, Civil/Structural/Architectural
D. Klein, Manager, Radiological, Nuclear, and Process Safety

D. Larson, Sr. Engineer, Process
P. Lowry, Central Integrated Safety Management (ISM) Supervisor, E&NS
S. Lynch, Deputy Manager of Engineering, Engineering Management
S. Makowski, Sr. Designer, C&I
C. McKnight, Fire Protection Supervisor, HVAC
M. Myatt, Discipline Engineering Manager, Plant Design
C. Nicholas, Sr. Engineer, C&I
J. Prescott, Sr. Designer, Electrical
S. Ramesh, Area Discipline Supervisor, Civil/Structural/Architectural
M. Rees, Architect Supervisor, Civil Structural and Architecture
R. Ravula, Sr. Engineer, Mechanical Systems
K. Smith, Engineer, C&I
A. Wong, Structural Design Lead, Civil/Structural/Architectural
S. Woolfolk, Hazard and Safety Analysis Lead, E&NS
M. Wright, Area Discipline Supervisor, Mechanical Systems

3.2 List of Inspection Procedures Used

ITP I-110, "SRD Design Standards Implementation Assessment," Revision 4, May 30, 2003

3.3 List of Items Opened, Closed, and Discussed

3.3.1 Opened

IR-03-016-01-AFI	Assessment Follow-up Item	Engineering specifications identified an edition of a code (i.e., AWS D1.1) that was different from the code edition identified in a DTD and in an SRD implementing standard (AISC N690-94). (Section 1.2.2)
IR-03-016-02-AFI	Assessment Follow-up Item	Revision of the Electrical Design Criteria and Guide to correct discrepancies with SRD Section 4 implementing codes and standards (IR-03-016-02-AFI). (Section 1.4.2)
IR-03-016-03-FIN	Finding	For ITS piping, pipe supports, and pump pressure casings, the Contractor used design codes and standards not contained in the SRD. This resulted in a Finding for failure to meet contractual requirements to implement the DOE-approved SRD. (Section 1.3.2)

IR-03-016-04-FIN	Finding	The Contractor failed to initiate CARs to address the use of unapproved codes and standards, although Contractor staff and management were aware of the non-compliance. (Section 1.3.2)

3.3.2 Closed

IR-02-012-02-IFI	Inspection Follow-up Item	There was no documented evidence the engineering specification for the PPJ, which was an ITS system with protective functions, complied with the single failure criteria for software common mode failures. (Section 1.4.2) Furthermore, the 19,600 psi calculated stress for the installed ductwork exceeded the ASME B31.3-96, Table A-1, allowable stress. (Section 1.5.2)

3.3.3 Discussed

IR-02-012-02-IFI	Inspection Follow-up Item	There was no documented evidence the engineering specification for the PPJ, which was an ITS system with protective functions, complied with the single failure criteria for software common mode failures. (Section 1.2.2)
IR-02-012-01a-FIN	Finding	Contractor Engineering Specification 24590-WTP-3PS-MV00-T0002, Rev. 0, Seismic Qualification Criteria for Pressure Vessels, used ASME Section III allowable stresses instead of ASME Section VIII allowable stresses. (Section 1.2.2)
IR-02-012-03-FIN	Finding	There was no documented evidence the Contractor had established a process that incorporated human factors engineering in the facility design. (Section 1.4.2)

IR-02-012-04-FIN	Finding	Contractor calculation 24590-HLW-P6C-P40T-00001, Rev. B, Stress Analysis Report of HLW C5 Embedded Steel Duct, used 20,000 psi as the allowable stress for accepting installed HLW C5V embedded ducting instead of the allowable 16,700 psi.

3.4 List of Acronyms

AB	authorization basis
ABAR	Authorization Basis Amendment Request
ABCN	Authorization Basis Change Notice
ACI	American Concrete Institute
AFI	Assessment Follow-up Item
AISC	American Institute of Steel Construction
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
B&PV	Boiler and Pressure Vessel Code
BNI	Bechtel National, Inc.
CAR	Corrective Action Report
CMTR	Certified Material Test Report
C&I	Controls and Instrumentation
DC	Direct Current
DTD	Decision to Deviate
DOE	U. S. Department of Energy
EMI	electromagnetic interference
ES&H	Environment, Safety and Health
ESQ&H	Environment, Safety, Quality and Health
FSAR	Final Safety Analysis Report
FHA	Fire Hazards Analysis
FR	Fire-Rated
HFE	Human Factors Engineering
HEPA	High-Efficiency Particulate Air
HLW	High Level Waste
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
I&C	Instrumentation and Control
IEEE	Institute of Electrical and Electronic Engineers, Inc.
ISA	Instrument Society of America
ITP	Inspection Technical Procedure
ITS	important-to-safety
LAW	Low Activity Waste
MAWP	Maximum Allowable Working Pressure

MR	Material Requisition
NFPA	National Fire Protection Association
NPH	natural phenomena hazard
OBE	Operating Basis Earthquake
ORP	Office of River Protection
PPJ	Programmable Protection System
PSAR	Preliminary Safety Analysis Report
QA	quality assurance
QAM	Quality Assurance Manual
QL	Quality Level
RFI	radiofrequency interference
SBS	submerged bed scrubber
SC	Safety Criteria
SDC	Safety Design Class
SDS	Safety Design Significant
SRD	Safety Requirements Document
SSC	structures, systems, and components
TEMA	Tubular Exchangers Manufacturers Association
UBC	Uniform Building Code
UL	Underwriter Laboratories
UPS	Uninterruptible Power Supply
WTP	Waste Treatment and Immobilization Plant