

U.S. Department of Energy, Office of River Protection

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**WASTE TREATMENT AND IMMOBILIZATION PLANT  
(WTP)  
DESIGN OVERSIGHT REPORT**

**REVIEW OF PRETREATMENT  
PROCESS CONTROL STRATEGY**

**March 2008**

**Design Oversight: D-08-DESIGN-061**

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## EXECUTIVE SUMMARY

The U.S. Department of Energy, Office of River Protection (ORP) initiated a design oversight of the Waste Treatment and Immobilization Plant (WTP) Project process control strategy for the Pretreatment (PT) Facility, with the following objectives:

- Review the PT Facility process control strategy documented in 24590-WTP-3YD-50-00002, *WTP Integrated Processing Strategy Description*, system descriptions, software functional specifications, and compliance plans to determine if a cohesive process control strategy exists.
- Review PT Facility process flow diagrams and piping and instrumentation diagrams to verify features required for the process control strategy are included in WTP design.
- Assess the effectiveness of the process control strategy:
  - Determine if the process control strategy will meet Contract and interface requirements.
  - Determine if the process control strategy will support plant throughput requirements.

On February 20, 2008, the Assessment Team met with WTP Contractor management and engineering staff to discuss the status of the PT process control strategy, identify changes that have been made from issued documentation, and identify where these changes are documented. However, based on the information obtained at the meeting, it was concluded the assessment could not be completed due to ongoing changes and lack of documentation of the WTP PT Facility process control strategy.

The WTP PT process control strategy is in a state of flux due to process and mechanical changes associated with resolution of External Flowsheet Review Team issues and capacity modifications to restore system capability. Bechtel National, Inc. stated the process control strategy would be documented in system description revisions, which will begin after October 2008.

The assessors recommend that the assessment be restarted and completed in late 2009 after the updated process control strategies are captured in the PT Facility system descriptions.

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## LIST OF ACRONYMS

BNI	Bechtel National Inc.
CNP	Cesium Nitric Acid Recovery Process System
Cs	cesium
CXP	Cesium Ion Exchange Process System
DOE	U.S. Department of Energy
EFRT	External Flowsheet Review Team
FEP	Waste Feed Evaporation Process System
FRP	Waste Feed Receipt Process System
FY	fiscal year
HLP	HLW Lag Storage and Feed Blending Process System
HLW	High-Level Waste [Facility]
IRP	Issue Response Plan
ISARD	Integrated Sampling and Analysis Requirements Document
ISM	integrated safety management
ITS	important-to-safety
LAW	Low-Activity Waste [Facility]
ORP	Office of River Protection
P&ID	pipng and instrumentation diagram
PFD	process flow diagram
PJM	pulse jet mixer
PJV	Pulse Jet Ventilation System
PSA	Plant Service Air System
PT	Pretreatment [Facility]
PVP	Pretreatment Vessel Vent Process System
PVV	Process Vessel Vent Exhaust System
PWD	Plant Wash and Disposal System
QAM	Quality Assurance Manual
RLD	Radioactive Liquid Waste Disposal System
SBS	submerged bed scrubber
SD	system description
TCP	Treated LAW Concentrate Storage Process System
TLP	Treated LAW Evaporation Process System
UFP	Ultrafiltration Process System
WED	WTP Engineering Division
WIPSD	<i>WTP Integrated Processing Strategy Description</i>
WTP	Waste Treatment and Immobilization Plant

## **1.0 INTRODUCTION**

The U.S. Department of Energy (DOE), Office of River Protection's (ORP) mission is to retrieve and treat Hanford's tank waste and close the tank farms to protect the Columbia River. In order to complete one major component of this mission, ORP awarded Bechtel National Inc. (BNI) a contract for the design, construction, and commissioning of the Waste Treatment and Immobilization Plant (WTP) at the Hanford Site in Richland, Washington. As part of its oversight responsibilities, ORP performs various assessments of BNI activities during the design and construction phase. This assessment evaluated the process control strategy for the WTP Pretreatment (PT) Facility.

## **2.0 BACKGROUND**

The WTP Engineering Division (WED) has responsibility for design oversight of the WTP Project, which is comprised of three primary processing facilities: Pretreatment (PT), High-Level Waste (HLW) vitrification, and Low-Activity Waste (LAW) vitrification. WED staff plans to perform a series of assessments in fiscal year (FY) 2008 to evaluate process control strategies for each of the primary process facilities.

WTP process control strategies are documented in 24590-WTP-3YD-50-00002, *WTP Integrated Processing Strategy Description* (WIPSD), as well as system descriptions, and software functional specifications. 24590-WTP-3YD-50-00002 provides a single document that links process flowsheet and upper-tier, processing-related requirements with selected monitoring and control approaches for normal operations of the primary waste processing facilities. System descriptions provide an overview description of the system, including functions, requirements, design operating parameters, and operational conditions and limits, and define the system technical basis and code requirements. Software functional specifications describe the functional design requirements of process and mechanical handling control system software.

## **3.0 OBJECTIVES, SCOPE, AND APPROACH**

### **3.1 Objectives**

The specific objectives of this oversight were to:

- Review the PT Facility process control strategy documented in the WIPSD (24590-WTP-3YD-50-00002), system descriptions, software functional specifications, as well as compliance plans to determine if a cohesive process control strategy exists.
- Review PT Facility process flow diagrams (PFD) and piping and instrumentation diagrams (P&ID) to verify that features required for the process control strategy are included in the WTP design.
- Assess the effectiveness of the process control strategy:
  - Determine if the process control strategy will meet WTP Contract and interface requirements.
  - Determine if the process control strategy will support plant throughput requirements.

### 3.2 Scope

This assessment included review of the WIPDS (24590-WTP-3YD-50-00002) and system descriptions associated with the PT Facility. Interviews and discussions were conducted with cognizant WTP BNI Engineering management and staff.

### 3.3 Approach

This oversight was conducted within the guidelines of ORP M 220.1, *Integrated Assessment Plan*, and ORP Desk Instruction (DI) 220.1 "Conduct of Design Oversight." The approved design product oversight plan, *WTP Engineering Division Assessment of Pretreatment Process Control Strategy*, is provided in Appendix A.

## 4.0 RESULTS

On February 20, 2008, the Assessment Team met with Contractor (BNI) management and engineering staff to discuss the status of the PT Facility process control strategy, identify changes that have been made from issued documentation, and identify where these changes are documented.

The Contractor identified that most of the PT Facility system descriptions are obsolete and there have been significant changes that are not reflected in the descriptions. The Contractor stated the major contributors to these changes were the result of External Flowsheet Review Team (EFRT) Issue Response Plan (IRP) actions, resolution of hydrogen in piping and ancillary vessel concerns, and capacity modifications recommended by the Contractor and approved by ORP to optimize system performance. Issues that are yet to be resolved that will affect the process control strategy include EFRT IRP M1 (Plugging in Process Piping [line plugging]), M3 (Inadequate Mixing System [vessel mixing]), M12 (Undemonstrated Leaching Process), and planned changes to 24590-WTP-PL-PR-04-0001, *Integrated Sampling and Analysis Requirements Document* (ISARD). Many details of the PT Facility process control strategy, including requirements for sampling for oxidative leaching control, sampling for criticality control, mixing, prevention of precipitation, and reagent additions, are not defined at this time.

The Contractor also stated most of the PT Facility P&IDs will change significantly and are in the process of being revised to incorporate required changes; P&IDs will be re-issued between late summer and October 2008. The Contractor stated that system description revisions will begin following completion of P&ID revisions. When asked where these design changes and revisions to process control strategies are captured, the Assessment Team was informed that there is limited documentation available; however, the system engineers know how their systems will be operated and controlled. Contractor management stated that to review the process control strategy, the Assessment Team would need to interview Process Engineering and Technology engineers and system engineers.

Based on the above information, the Assessment Team concluded that the Contractor's PT Facility process control strategy was not documented and in a state of flux. While engineers may have a concept of the process control strategy, there would be questionable pedigree and no configuration control of information gathered in an assessment relying primarily on gathering

information from interviews. ORP and BNI concluded the assessment could not be completed at this time due to lack of documentation of the WTP PT Facility process control strategy.

The Assessment Team reviewed upper-tier procedures to evaluate BNI's maintenance of current and accurate design input requirements (process control strategy). 24590-WTP-DB-ENG-01-001, *Basis of Design*, provides WTP Project Level 3 design criteria. 24590-WTP-DB-ENG-01-001, Section 6, "Process Basis of Design," requires system descriptions to be the integrating point for all process control requirements. Control strategies are optimized at the systems level. The optimized control strategies become input to the design of instrumentation and/or sampling and analysis plans.

24590-WTP-QAM-QA-06-001, *Quality Assurance Manual (QAM)*, Policy Q-03.1, "Design Control," dictates how design criteria inputs are controlled per the following requirements (in italics):

- 3.1.2.2, "Design Input," 3.1.2.2.1. *Applicable design inputs shall be identified and documented, and their selection reviewed and approved. (NQA-I-2000, RQMT 3,200; QARD, Rev 18, 3.2.1 .A)*
- 3.1.2.2, "Design Input," 3.1.2.2.2. *The design input shall be specified to the level of detail necessary to permit the design activities to be carried out in a correct manner and to provide a consistent basis for making design decisions, accomplishing design verification measures, and evaluating design changes. (NQA-I-2000, QMT 3.200; QARD, Rev 18, 3.2.1 .B)*

Without a current process control strategy, design activities are at risk and may not be carried out in a correct manner.

Issues not addressed in current design media capturing the PT Facility process control strategy include:

- Sampling with appropriate mixing requirements in vessels HLP-VSL-00022, FEP-VSL-00017A/B, FRP-VSL-00002A/B/C/D, and UFP-VSL-00001A/B. The ultrafiltration system operation is based on preparing a batch in UFP-VSL-00001A/B with feed from HLP-VSL-00022, FEP-VSL-00017A/B, and FRP-VSL-00002A/B/C/D. This material must be characterized to allow appropriate caustic and permanganate additions in the ultrafiltration system caustic and oxidative leaching processes. Mixing requirements for process control in these vessels are not clearly specified. Mixing requirements for process control include mixing for adequate characterization and mixing to allow transfer of a batch of waste with known content. Also, sampling is not routinely performed on the FEP-VSL-00017A/B material to determine content.
- Process controls for caustic leaching in ultrafiltration feed preparation vessels (UFP-VSL-00001A/B) have not been addressed in the process control strategy.
- Approaches to control precipitation downstream of the ultrafiltration system are not addressed in the PT Facility process control strategy.

For example, a previous design oversight assessment of the potential for post-filtration precipitation in the PT Facility<sup>1</sup> identified the potential for the precipitation and accumulation of large quantities of alumina and other solids in the Treated LAW Evaporation and Concentrate Storage Process System (TLP) evaporator (TLP-SEP-00001) and the Treated LAW Concentrate Storage Process System (TCP) vessel (TCP-VSL-00001). While the Contractor has acknowledged that additional sampling and analysis is required to control adverse precipitation, specific recommendations have not yet been made.

- Approaches to monitor for plutonium in the ultrafiltration system permeate for criticality control are not addressed in the PT Facility process control strategy.

These issues are being addressed in the EFRT IRPs for M1, M3, M12, and ongoing safety analyses.

Given the state of design evolution and ongoing process control strategy definition, it was judged to be premature to reach conclusions regarding compliance with the QAM requirements for design control. The assessors concluded the assessment should be restarted in late 2009 after the PT Facility process control strategies are captured in system descriptions.

## **5.0 CONCLUSIONS**

Based on the information reviewed and information obtained during the meeting between the Assessment Team and Contractor management and engineering staff, the Assessment Team concluded that the assessment could not be completed due to lack of documentation of the WTP PT Facility process control strategy.

The WTP PT process control strategy is in a state of flux due to process and mechanical changes associated with resolution of EFRT issues and capacity modifications to restore system capability. BNI stated the process control strategy would be documented in system description revisions which will begin revision after October 2008.

The assessors recommend that the assessment be restarted and completed in late 2009 after the process control strategies are captured in the PT Facility system descriptions.

## **6.0 PERSONNEL CONTACTED AND REFERENCES**

### **6.1 Personnel Contacted**

BNI Engineering

- Rick Brouns
- Klemme Herman
- Chris Musick
- John Olson
- Neal Schertz
- Ed Streiper
- Bob Voke

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<sup>1</sup> D-07-DESIGN-053, *Waste Treatment and Immobilization (WTP) Design Assessment of Pretreatment Facility Post Filtration Precipitation*, dated October 2007



BNI Quality Assurance  
– D. Kammenzind

## **6.2 References**

D-07-DESIGN-053, *Waste Treatment and Immobilization (WTP) Design Assessment of Pretreatment Facility Post Filtration Precipitation*, dated October 2007

24590-WTP-3YD-50-00002, *WTP Integrated Processing Strategy Description*, Rev. 0, Bechtel National, Inc.

24590-WTP-DB-ENG-01-001, *Basis of Design*, Rev. 1J, Bechtel National, Inc.

24590-WTP-PL-PR-04-0001, *Integrated Sampling and Analysis Requirements Document*, Rev. 1, Bechtel National, Inc.

ORP DI 220.1, “Conduct of Design Oversight,” Rev. 1, U.S. Department of Energy, Office of River Protection

ORP M 220.1, *Integrated Assessment Program*, Rev. 5, U.S. Department of Energy, Office of River Protection

## **Appendix A. DESIGN PRODUCT OVERSIGHT PLAN**

U.S. Department of Energy, Office of River Protection

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## DESIGN PRODUCT OVERSIGHT PLAN

### WTP ENGINEERING DIVISION ASSESSMENT OF PRETREATMENT PROCESS CONTROL STRATEGY

January 2008

Design Oversight: D-08-DESIGN-061

**Submitted by:**

original signed by \_\_\_\_\_  
R.A. Gilbert, Team Lead  
WTP Engineering Division

Date \_\_\_\_\_

**Concurrence:**

\_\_\_\_\_  
J.H. Wicks, Director  
WTP Engineering Division

Date \_\_\_\_\_

\_\_\_\_\_  
John Eschenberg, Project Manager WTP

Date \_\_\_\_\_

## **1.0 BACKGROUND, PURPOSE AND OBJECTIVES**

### **1.1 Background**

The Waste Treatment and Immobilization Plant (WTP) Engineering Division (WED) has responsibility for the design oversight of the WTP. The WTP is comprised of three primary processing facilities: Pretreatment (PT), High-Level Waste (HLW) Vitrification, and Low-Activity Waste (LAW) Vitrification. WED will perform a series of three assessments to evaluate process control strategies for each of the primary process facilities. The results of the first of these reviews are documented in report D-07-DESIGN-054, *Review of Low-Activity Vitrification Process Control Strategy*.

WTP Process control strategies are documented in the WTP integrated processing strategy description, system descriptions, and software functional specifications. The WTP integrated processing strategy description provides a single document that links process flowsheet and upper-tier processing related requirements with selected monitoring and control approaches for normal operations of the primary waste processing facilities. System descriptions provide an overview description of the system, including functions, requirements, design operating parameters and operational conditions and limits, and define the system technical basis and code requirements. Software functional specifications describe the function of instruments in the design and will provide process set points in the future.

### **1.2 Purpose**

This design oversight assessment will review the process control strategy and design associated with the PT Facility.

### **1.3 Objectives**

The following are specific objectives of this assessment:

- Review the PT Facility process control strategy documented in the WTP Integrated processing strategy description, system descriptions, software functional specifications, and compliance plans to determine if a cohesive process control strategy exists.
- Review PT Facility process flow diagrams (PFD) and piping and instrumentation diagrams (P&ID) to verify features required for the process control strategy are included in WTP design.
- Assess the effectiveness of the process control strategy.
  - Determine if the process control strategy will meet Contract and interface requirements.
  - Determine if the process control strategy will support plant throughput requirements.

## 2.0 PROCESS

This oversight shall be conducted within the guidelines of ORP M 220.1, *Integrated Assessment Plan*, and the ORP Desk Instruction DI 220.1 “Conduct of Design Oversight,” Rev. 1, as revised January 13, 2006.

### 2.1 Scope

This assessment will include review of the WTP integrated processing strategy description, system descriptions, software functional specifications, PFDs and P&IDs associated with the PT Facility.

The team will be comprised of five ORP WED staff members:

- R. Gilbert
- L. Holton
- L. McClure
- M. McCormick-Barger
- K. Sandroni

### 2.2 Preparation

1. Identify Contractor Point of Contact for review.
2. Confirm with Contractor staff that documentation being reviewed is the most current approved revision.
3. Prepare detailed lines of inquiry.

Table 1 provides a list of the initial information requirements needed for the review.

**Table 1 – Initial Information Requirements**

1.	Point of contact for the assessment
2.	Latest revisions of the WTP Integrated processing strategy description
3.	Latest revision of the PT Facility PFDs and P&IDs
4.	Latest revision of PT Facility system descriptions and software functional specifications
5.	Identification of compliance plan and interface requirements that rely on PT Facility process control

### 2.3 Assessment

The assessors will review the requested documentation to assess each of the objectives identified in Section 1.3 of this plan. Based on this assessment, specific lines of inquiry for use in discussion and interviews will be prepared. Notes will be retained identifying the document title and number reviewed and results of the review for use in preparing assessment notes (detailed responses and assessment of lines of inquiry) which will be written by each team member as input to the report.

The Team Lead will de-brief ORP and Contractor management periodically as required. The Team Lead will prepare a draft report that summarizes the activities, the results and conclusions of the review. The Assessment Team will issue the Draft Design Oversight Report for ORP management and Contractor review and comment. The final report will resolve comments received on the draft report.

### 3.0 SCHEDULE OF ACTIVITIES

Table 2 summarizes the schedule of this assessment.

### 4.0 DOCUMENTATION

The final report of this task shall contain the sections and content as summarized in ORP Desk Instruction DI 220.1 “Conduct of Design Oversight,” Rev. 1.

Conclusions from this assessment shall be documented in the final report. Issues shall be assigned an item number for tracking in the Consolidated Action Reporting System (CARS). The final report will be transmitted to the Contractor.

### 5.0 CLOSURE

The Team Lead, with concurrence of the Director, shall confirm that follow-up items and findings from this oversight, if any, are adequately resolved.

**Table 2 – Schedule**

Activity Description	Responsibility	Complete By
Develop Design Oversight Plan	Gilbert	1/14/08
Provide Design Oversight Plan to Contractor	Gilbert	1/18/08
Identify Point of Contact (POC)	WTP	1/25/08
Obtain Contractor documentation defined in Table 1 above to support review and provide to team members	Gilbert WTP POC	1/30/08
Qualify Team members	Gilbert/Wicks	1/31/08
Kick-off meeting with Contractor to outline objectives, scope, schedule, and establish POCs	WTP POC Gilbert	2/11/08
Review documents from Contractor and provide oversight strategy, lines of inquiry, and interview requests to team lead	Team	2/11/08
Review Contractor documents, participate in relevant Contractor internal meetings and meet with Contractor as required	Team	2/29/08
Complete Design Oversight Notes	Team	3/7/08
ORP and Contractor Exit Briefing	Gilbert WTP POC	3/21/08
Draft Report	Gilbert	3/21/08
Resolve Comments and place Final Report into concurrence including factual accuracy review with Contractor	Gilbert	3/28/08

Approve Final Report	ORP	3/31/08
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