U.S. Department of Energy
[redacted]
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Richland, Washington 99352

OCT 01 2007

07-WTP-262

Mr. C. M. Albert, Project Manager
Bechtel National, Inc.
2435 Stevens Center Place
Richland, Washington 99354

Dear Mr. Albert:

CONTRACT NO. DE-AC27-01RV14136 – TRANSMITTAL OF U.S. DEPARTMENT OF ENERGY (DOE), OFFICE OF RIVER PROTECTION (ORP) DESIGN ASSESSMENT REPORT NUMBER D-07-DESIGN-048: DESIGN ASSESSMENT OF PRETREATMENT (PT) FACILITY PROCESS SYSTEMS IN THE CESIUM ION EXCHANGE PROCESS SYSTEM (CXP) AND CESIUM NITRIC ACID RECOVERY PROCESS SYSTEM (CNP) BLACK CELLS

The purpose of this letter is to notify Bechtel National, Inc. (BNI) of the results of the ORP Design Assessment of the PT Facility Process Systems in the CXP and CNP Black Cells. The Assessment Team reviewed BNI engineering and applicable procurement documents associated with the process vessels located in black cells P-0111 and P-0112. Based on a review of materials evaluation, and selection documentation, the team concluded that the materials selection process for the process vessels and piping in the CXP and CNP black cells is acceptable.

The Assessment Team also reviewed black cell access. The current design provides for maintenance access from the 56-foot elevation to the Feed Evaporation Process evaporator in black cell P-0106 and the CNP evaporator in black cell P-001 through labyrinth seal concrete plugs. DOE recognized that the remaining black cells [1] in the PT Facility could be accessed through heating, ventilation, and air conditioning access. Adding access through plugs to the black cells other than at the points designated would be largely ineffective since a reasonable projection of where such a failure might occur cannot be reasonably predicted.

Last, in parallel with this review, ORP completed a series of Technology Readiness Assessments (TRA)[2] for the Waste Treatment and Immobilization Plant facilities; in particular, the PT TRA encompasses the CXP and CNP. (The Assessment Team used the PT TRA during its review of these two systems' black cells.) As a result of the TRA reviews, ORP identified system design and operating issues with the CXP and CNP. In response, ORP and BNI are preparing two Issue Response Plans (IRP) as follows:

- The CXP IRP will evaluate the adequacy of the design concept for the Cesium Ion Exchange Vessel, CXP-VSL-00001. This vessel will be re-evaluated to determine a need for waste mixing, heating/cooling, and chemical addition capability based on recent

[1] ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Black Cell Access," 04-WED-034, dated July 2, 2004.
[2] DOE/ORP-2007-02, *Technology Maturation Plan – Technology Readiness Assessment Reports for the Waste Treatment and Immobilization Plant Project Facilities*, Volume II, draft, September 2007.

external flowsheet review plans to resolve issues such as solids precipitation of aluminum in the CXP.

- The CNP IRP proposes to resolve design issues through equipment modifications or additions to be defined in a CNP closure report. The closure report is to reflect the results of a detailed design review (including external expert review), and may include results of bench-scale and/or prototypical system tests.

As stated, the Assessment Team concluded that the materials selection process for the process vessels and piping in the CXP and CNP black cells is acceptable. However, since the CNP will be exposed to strong acids (nitric acid) and fluctuating chemical conditions, a materials review will be included in the CNP IRP.

This design assessment is for informational purposes only. The Assessment Team did not identify any new issues beyond those identified separately in the PT TRA. The two IRPs identified above were determined sufficient to address those issues identified during the TRA review. No further actions are required.

If you have any questions, please contact me, or your staff may call Bob Griffith., Acting Director, WTP Project Engineering Division, (509) 372-2821.

Sincerely,

John R. Eschenberg, Project Manager
Waste Treatment and Immobilization Plant Project

WTP:DHA

Attachment

cc w/attach:
W. Clements, BNI
W. S. Elkins, BNI
K. Reutell, BNI
J. Roth, BNI
G. Shell, BNI
BNI Correspondence

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

DESIGN ASSESSMENT

WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) DESIGN ASSESSMENT OF PRETREAMENT FACILITY PROCESS SYSTEMS IN THE CESIUM ION EXCHANGE PROCESS SYSTEM (CXP) AND CESIUM NITRIC ACID RECOVERY PROCESS SYSTEM (CNP) BLACK CELLS

SEPTEMBER 2007

DESIGN OVERSIGHT: D-07-DESIGN-048

Team Lead: Victor L. Callahan, Nuclear Safety
Waste Treatment and Immobilization Plant Project (WTP)
Engineering Division (WED)

Team Member: Don Alexander, Chemical Processing, WED

Team Member: Mike Evarts, ORP Acceptance Inspector, Project Assistance Corporation (PAC)

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE), Office of River Protection (ORP) Waste Engineering Division (WED) staff conducted a limited follow-on design oversight on the adequacy of Pretreatment (PT) Facility black cells. As part of this assessment, the team specifically reviewed the PT Facility process systems in the Cesium Ion Exchange Process System (CXP) and Cesium Nitric Acid Recovery Process System (CNP) black cells, P-0111 and P-0112, respectively.

The Assessment Team reviewed Bechtel National, Inc.'s (BNI) engineering and applicable procurement documents associated with the process vessels located in black cells P-0111 and P-0112. Based on a review of materials evaluation, and selection documentation, the team concluded that the materials selection process for the process vessels and piping in the CXP and CNP black cells is acceptable. The team's review also indicates that BNI appears to have adequate provisions in place to meet the requirements of the Safety Requirements Document (SRD), Safety Criterion 4.2-2, citing ASME Section VIII, *Boiler and Pressure Vessel Codes*, requirements as well as requirements from SRD, Appendix H, "Ad Hoc Implementing Standard for Erosion/Corrosion and Assessments," regarding the design features of vessels and piping. Specifically, Appendix H provides for a design life of 40 years without in-service inspection defined for inaccessible areas. Procurement records indicate that these requirements were implemented during vessel fabrication.

The Assessment Team also reviewed black cell access. The current design provides for maintenance access from the 56-foot elevation to the Feed Evaporation Process evaporator in black cell P-0106 and the CNP evaporator in black cell P-001 through labyrinth seal concrete plugs. DOE recognized that for the remaining black cells all but two of the black cells [1] in the PT Facility could be accessed through heating, ventilation, and air conditioning (HVAC) access. Adding access through plugs to the black cells other than at the points designated would be largely ineffective since a reasonable projection of where such a failure might occur cannot be reasonably predicted.

Last, in parallel with this review, ORP completed a series of Technology Readiness Assessments (TRA)[2] for the Waste Treatment and Immobilization Plant facilities; in particular, the PT TRA encompasses the CXP and CNP. (The Assessment Team used the PT TRA during its review of these two systems' black cells.) As a result of the TRA reviews, ORP identified system design and operating issues with the CXP and CNP. In response, ORP and Bechtel National, Inc. (BNI) are preparing two Issue Response Plans (IRP) as follows:

- The CXP IRP will evaluate the adequacy of the design concept for the cesium ion exchange vessel, CXP-VSL-00001. This vessel will be re-evaluated to determine a need for waste mixing, heating/cooling, and chemical addition capability based on recent external flowsheet review plans to resolve issues such as solids precipitation of aluminum in the CXP.

[1] ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Black Cell Access," 04-WED-034, dated July 2, 2004.
[2] DOE/ORP-2007-02, *Technology Maturation Plan – Technology Readiness Assessment Reports for the Waste Treatment and Immobilization Plant Project Facilities*, Volume II, draft, September 2007.

- The CNP IRP proposes to resolve design issues through equipment modifications or additions to be defined in a CNP closure report. The closure report is to reflect the results of a detailed design review (including external expert review), and may include results of bench-scale and/or prototypical system tests.

As stated, the Assessment Team concluded that the materials selection process for the process vessels and piping in the CXP and CNP black cells is acceptable. However, since the CNP will be exposed to strong acids (nitric acid) and fluctuating chemical conditions, a materials review will be included in the CNP IRP.

This design assessment is for informational purposes only. The Assessment Team did not identify any findings beyond those identified separately in the PT TRA. The two IRPs identified above were determined sufficient to address those issues identified during the TRA review. No further actions are required.

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LIST OF ACRONYMS

ASME	American Society of Mechanical Engineers
AUT	automated ultrasonic testing
BNI	Bechtel National, Inc.
CNP	Cesium Nitric Acid Recovery Process System
CXP	Cesium Ion Exchange Process System
DOE	U.S. Department of Energy
HLP	HLW Lag Storage and Feed Blending Process System
HLW	High-Level Waste [Facility]
HVAC	heating, ventilation, and air conditioning
IRP	Issue Response Plan
IX	ion exchange
LAW	Low-Activity [Facility]
MSDS	material selection datasheet
NDE	non-destructive examination
ORP	Office of River Protection
PJM	pulse jet mixer
PT	Pretreatment [Facility]
RF	resorcinol formaldehyde
SRD	Safety Requirements Document
TLP	Treated LAW Feed Evaporator System
TMP	Technology Maturation Plan
TRA	Technology Readiness Assessment
TRL	Technology Readiness Level
UFP	Ultrafiltration Process System
WED	WTP Engineering Division
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 Site 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. The purpose of this assessment is to evaluate the follow-on design oversight on the adequacy of Pretreatment (PT) Facility black cells since ORP issued its initial assessment report in February 2004[3].

2.0 BACKGROUND

In order to meet the requirements of the WTP contract, BNI has constructed black cells in the PT Facility. These black cells contain vessels and piping systems in which no active waste processing occurs. The black cell concept is used in areas with a low risk of vessel failure, thereby achieving a reduced design capital cost compared to a comparably equipped, fully remote-accessible hot cell.

In February 2004, ORP issued a general report[3] on black cell design adequacy that identified a number of issues requiring further evaluation:

- Materials Selection: The technical basis for the selection of materials of construction and the establishment of the corrosion and erosion wear allowances are not defensible. The requirements (WTP Contract and process chemistry material balances) are not clearly linked to the material selection process. The rationale for the material selection, as provided in the corrosion evaluation, is not presented in clear, concise terms. The basis for the establishment of the erosion allowances is not traceable to the supporting documentation.
- Process Chemical Engineering: The Engineering organization developed a mass balance for the WTP to define fluid chemistry and operating conditions; e.g., pressure and temperature for every process stream throughout the plant.
- Non-Destructive Examination (NDE): For field fabricated piping and installation, BNI intends to use an automated ultrasonic testing (AUT) process for the NDE of butt-welded field welds at the WTP. The development and implementation of this AUT process for the NDE of field welds at the WTP is only in its initial stages.
- Black Cell Accessibility: BNI should evaluate the feasibility of modifying existing black cell openings such as heating, ventilation, and air conditioning (HVAC) or construction openings for future access to support unforeseen maintenance.

As a follow up, the Assessment Team evaluated these issues as they pertain specifically to the PT Facility Cesium Ion Exchange Process System (CXP) black cell P-0111 and the Cesium

[3] ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Submittal of U.S. Department of Energy, Office of River Protection (ORP) Design Oversight Report on Black Cell Design Adequacy," 04-WEC-005, dated February 11, 2004.

Nitric Acid Recovery Process System (CNP) black cell P-0112 (Planning Areas 8 and 9, respectively).

In addition, a recent draft Technology Readiness Assessment (TRA)[4] was completed for the PT Facility in which two primary issues were raised with the CXP and the CNP. These issues were further evaluated within this design oversight review as they pertain specifically to the CXP black cell P-0111 and CNP black cell P-0112 (Planning Areas 8 and 9, respectively):

- Mixing in CXP-VSL-0001: Confirmatory testing to validate the mixing performance of pulse jet mixers (PJM) mixed vessels containing low-solid concentrations (e.g., Newtonian fluids) has not been completed. Specific, quantifiable design requirements for the PJM technology have not been established to support testing evaluation and design confirmation. The mixing functional requirements will consider the credited safety functions of the vessels and the anticipated waste characteristics in this vessel.
- Immature CNP Design: As part of the PT Facility TRA, the CNP was numerically rated as a Technology Readiness Level (TRL) 3[5] because testing to measure the physical properties of the anticipated process waste solutions and provide information for thermodynamic modeling has only been completed on a laboratory scale. Confirmation testing of the CNP equipment components (reboiler, separator vessel, condenser, demisters, and rectifier column) has not been completed. Computer simulation of the CNP operation has not included the full composition range of feed solutions. Proposed changes with the CNP flowsheet, including neutralization of the cesium concentrate acidic product (CNP evaporator concentrate prior to transferring the waste to the High-Level Waste [HLW] Lag Storage and Feed Blending Process System [HLP]) and potential impacts for changing the resin medium from SuperLig® 644 to resorcinol formaldehyde (RF) resin, have not been evaluated.

3.0 OBJECTIVES, SCOPE, AND APPROACH

3.1 Objectives

The following were the specific objectives of this oversight:

1. Review black cell design process (the Assessment Team selected CXP black cell P-0111 and CNP black cell P-0112) to ensure the following:
   - Boundaries on primary drawings and documents
   - Requirements on physical fabrication and construction drawings
   - Requirements in procurement specifications and datasheets

In addition, as part of this objective, the Assessment Team reviewed the derivation of mixing requirements for CXP-VSL-00001 to determine if mixing systems would be adequate.

2. Evaluate materials selection process and basis for the selection of the vessel and piping material based on:

[4] 07-DESIGN-047, *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility*, draft, September 2007.

[5] The Technology Readiness Level or TRL is a means of assessing technology maturity prior to design transition.

- Estimation of erosion allowance
- Completed material selection datasheets

3. Review the Operational Process Chemical Engineering:
   - Process engineering organization of the mass balance for the CNP
   - Assessment of waste stream chemistry and operating conditions of the CNP
4. Review construction planning, requirements, and methods employed in NDE and evaluation of results
5. Review black cell accessibility considerations for potential future maintenance or unanticipated black cell repairs

3.2 Scope

The scope of this oversight assessment included review of project plans, procedures, and records associated with the process design in the WTP PT Facility CXP black cell P-0111 and CNP black cell P-0112 (Planning Areas 8 and 9, respectively).

3.3 Approach

ORP conducted this oversight within the guidelines of ORP DI 220.1, "Conduct of Design Oversight," Rev. 1, issued January 26, 2006. ORP collected information from various BNI and DOE documents and conducted interviews with BNI design staff. The approved design oversight plan, *Follow-on Review of Waste Treatment and Immobilization Plant (WTP) Pretreatement (PT) Facility Vessel Black Cell Design Adequacy Oversight*, is provided in Appendix A. The oversight plan was de-scoped to specifically address the CXP and CNP black cells.

4.0 BLACK CELL MATERIAL SELECTION

An analysis of probable corrosion rates and re-evaluation of materials of construction selection will be performed under the Technology Maturation Plan (TMP) based on the required 40-year CNP operating life (DOE/ORP-2007-02). This study will coincide with the TMP Design Review of the CNP. An IRP on the CNP is being prepared that will address material selection.

5.0 CNP PROCESS CHEMICAL ENGINEERING

The process chemistry of the CNP will be evaluated under the TMP. The TMP IRP will prescribe selected alternatives that will be modeled to confirm chemistry, energy and material balances using the ESP and AspenTech simulation software packages. The Aspen operations model will be used to analyze control system response during the batch-continuous CNP operations cycle. An IRP on the CNP is being prepared that will address process chemical engineering.

6.0 APPLICATION OF WELDING REQUIREMENTS AND NON-DESTRUCTIVE EXAMINATION (NDE)

The Assessment Team reviewed the following documents to determine the application of welding requirements and implementation of NDE work associated with vessels in the CXP black cell (P-0111) and the breakpot in the CNP black cell (P-0112):

- 24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication*, Rev. 2, July 12, 2004
- Mechanical Data Sheet – 24590-PTF-MV-CXP-00001, Rev. 1, *Equipment Assembly Cs IX Vessel – CXP-VSL-0001 (Q)*, draft
- Mechanical Data Sheet – 24590-PTF-MV-CXP-00004, Rev. 1, *Conceptual Design of Cesium Ion Exchange Column – CXP-VSL-0001 (Q)*, draft
- Mechanical Data Sheet – 24590-PTF-MV-CNP-00003, Rev. 1, *Equipment Assembly Cesium Eluate Breakpot CNP-BRKPT-00002*, April 16, 2007

Based on its review, the Assessment Team concluded BNI has adequate provisions in place to meet the requirements of Safety Requirements Document (SRD), Safety Criterion 4.2-2 regarding complying with American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code*. The team also concluded that BNI met the following requirements listed in the SRD, Appendix H, "Ad Hoc Implementing Standard for Erosion/Corrosion and Assessments":

- Correct Material Selection – Materials are selected and evaluated to ensure they are compatible with the expected operating conditions (including temperature, pH, and chemistry) and will last for a design life of 40 years.
- Vessel Design –The vessels are designed, fabricated, installed, and tested to ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1, which is the industry standard for nuclear-grade vessel design.
- Traceability of Materials – Traceability (such as identification of the item to applicable specification and grade of material, heat, batch, or serial number or specified inspection, test, or other records) is required when specified by codes, standards, or specifications.
- Control of Welding Processes – Acceptable welding processes are defined in welding specification used for vessels and piping.
- Positive Material Identification – Positive Material Identification is used to check to ensure the correct material has been used in shop fabricated vessels and piping and in selected field pipe welds where corrosion is a concern.
- Volumetric Inspection – Full volumetric inspection of the welds in the primary confinement boundary of vessels and of the girth welds in process piping is performed to ensure the defects are discovered and repaired.
- Leak Tests – Hydrostatic or pneumatic tests will be used to ensure that the vessels and process equipment are leak tight prior to startup.

Procurement records indicated the tank fabricator implemented these requirements during fabrication of the vessels in the black cell.

7.0 BLACK CELL ACCESSIBILITY CONSIDERATIONS

The current design provides for maintenance access from the 56-foot elevation to the Feed Evaporation Process evaporator in black cell P-0106, and the CNP evaporator in black cell P-0112. This access is provided by two massive labyrinth seal concrete plugs. The project has one planned access point into Planning Areas 8 and 9 of the PT Facility. There is an access path to the black cell provided through the C3 area for maintenance of the CNP evaporator. Currently, the only other planned access within the PT Facility is into the receipt vessel cell in Planning Area 1. DOE recognized that for the remaining black cells all but two of the black cells in the PT Facility could be accessed through HVAC access. The current design requires heroic methods to access black cell areas; this includes temporarily shoring a path that may be needed to remove plugs or casked equipment. Adding access through plugs to the black cells other than at the points designated would be largely ineffective since a reasonable projection of where such a failure might occur cannot be reasonably predicted. Based on this review, the Assessment Team concurs with the black cell access approach proposed by BNI to utilize HVAC access where possible. Otherwise, the approach is to provide a new entry through black cell walls.

8.0 SYSTEM OVERVIEWS OF THE CXP AND CNP BLACK CELLS

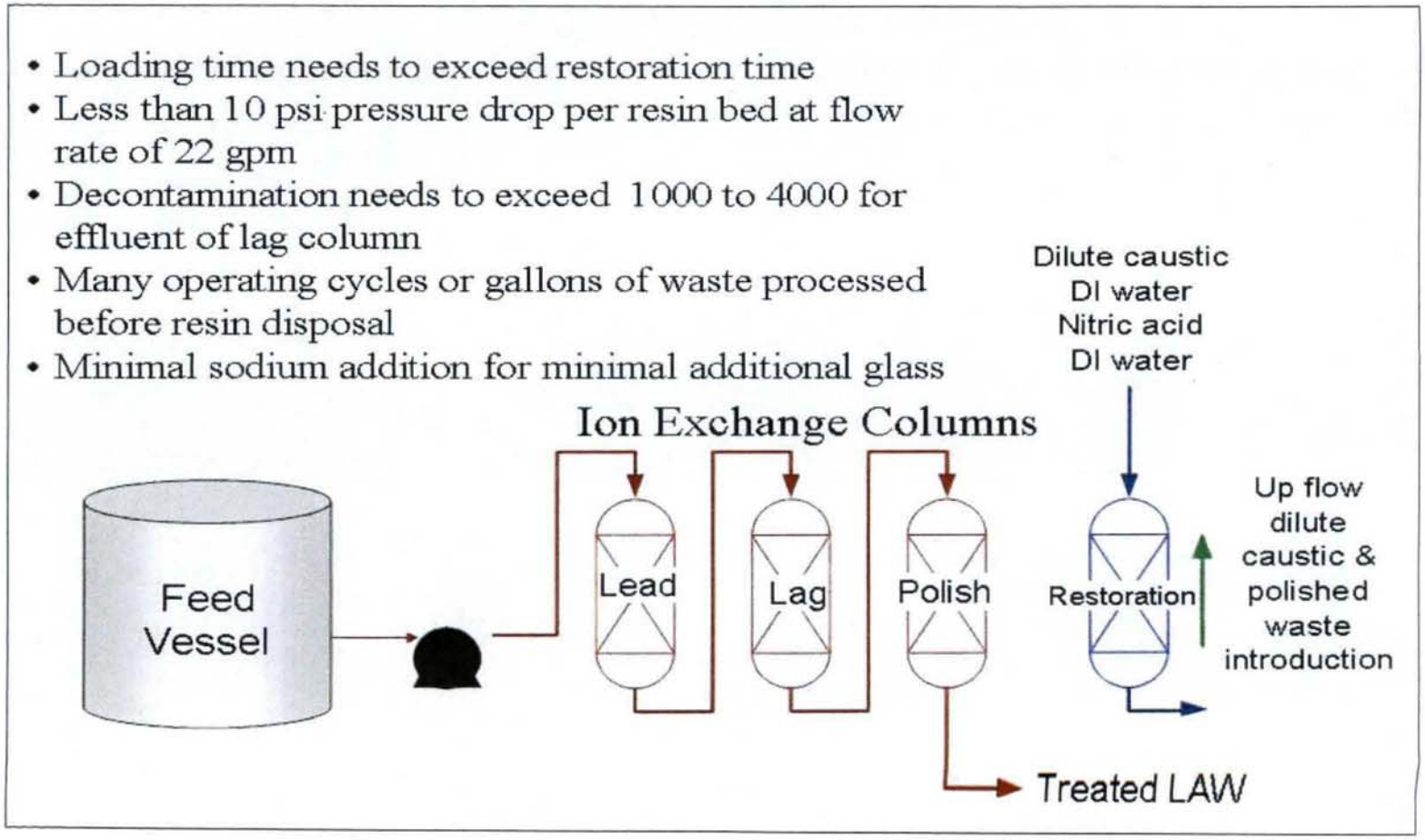
To better understand the CXP and CNP, the Assessment Team reviewed the information contained in the PT TRA, 07-DESIGN-047, *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility*. A team comprised of staff from the DOE ORP, technical consultants to ORP, and DOE Office of Environmental Management, Office of Project Recovery conducted the PT TRA to evaluate the technologies used in PT Facility and to assess the technical maturity (i.e., TRL rating) of the WTP design. The Assessment Team for this design review did not repeat the TRA review team's efforts; however, specific system and design information from 07-DESIGN-047 is provided in the following sections as it relates to this design review.

8.1 Cesium Ion Exchange Process System (CXP) - Mixing in CXP-VSL-0001

The CXP is described in 24590-PTF-3YD-CXP-00001, *System Description for the Cesium Ion Exchange Process – System CXP*. A block flow diagram of the CXP is provided in Figure 1. The primary functions of the CXP are to receive ultrafiltration permeate from the Ultrafiltration Process System (UFP), remove cesium from the UFP permeate using ion exchange (IX), transfer the cesium-treated low-activity waste (LAW) (e.g., eluate) to the Treated LAW Feed Evaporator System (TLP), and maintain hydrogen to a concentration below the lower flammability limit. UFP permeate solution is transferred from the three UFP permeate vessels to the cesium IX feed vessel (CXP-VSL-00001). Because the IX media (resin) has a limited capacity for cesium, the CXP requires an elution using dilute nitric acid and post-elution rinse to regenerate the resin media. This eluate is sent to the CNP evaporator where the nitric acid is recovered and the cesium and other salts are concentrated before transferring to the HLW Lag Storage and Feed Blending System (HLP).

There is potential precipitation in CXP-VSL-0001 as a consequence of the cooling of permeate passing through the ultrafiltration system. This accumulation of solids will require mixing components not currently in the CXP-VSL-0001 design. This issue was also identified as part of the PT TRA.

Figure 1. Block Flow Diagram for the Cesium Ion Exchange Process System



8.2 Cesium Nitric Acid Recovery Process System (CNP) – Immature System Design

The CNP is described in 24590-PTF-3YD-CNP-00001, *System Description for the Pretreatment Facility Cs Nitric Acid Recovery Process (CNP) System.* A block flow diagram of the CNP is provided in Figure 2. The primary functions of the CNP are to receive eluate from the CXP; concentrate the eluate; transfer eluate concentrate to the HLP; and recover the evaporator overheads stream as nitric acid eluent for reuse in the CXP.

Cesium eluate and rinse water are sent from the CXP on a periodic basis to the cesium evaporator breakpot. The eluate received from the IX column is, on average, more dilute than the 0.5M nitric acid used for elution. In addition, the concentration of nitric acid will vary throughout the elution cycle starting with a more dilute concentration, reaching a maximum concentration, and ending with a more dilute concentration. This fluctuation raised a concern during this review.

The fluctuation occurs because hydrogen ions are exchanged with eluted cations (aluminum, calcium, cesium, potassium, sodium, etc.) on the IX resin during the elution process and because some wash water (used for displacing residual caustic and nitric acid from the IX column) will precede and follow the eluate transfers to the evaporator. The breakpot may also receive infrequent transfers of eluate or concentrate from the eluate contingency storage vessel that will also cause chemical fluctuations.

The function of the CNP is to support uninterrupted and continuous operation of the CXP by:

- Receipt and vacuum concentration of as-produced eluate from the CXP
- Recovery of essentially cesium-free nitric acid for reuse as CXP eluant
- Transfer of cesium concentrate to the HLP

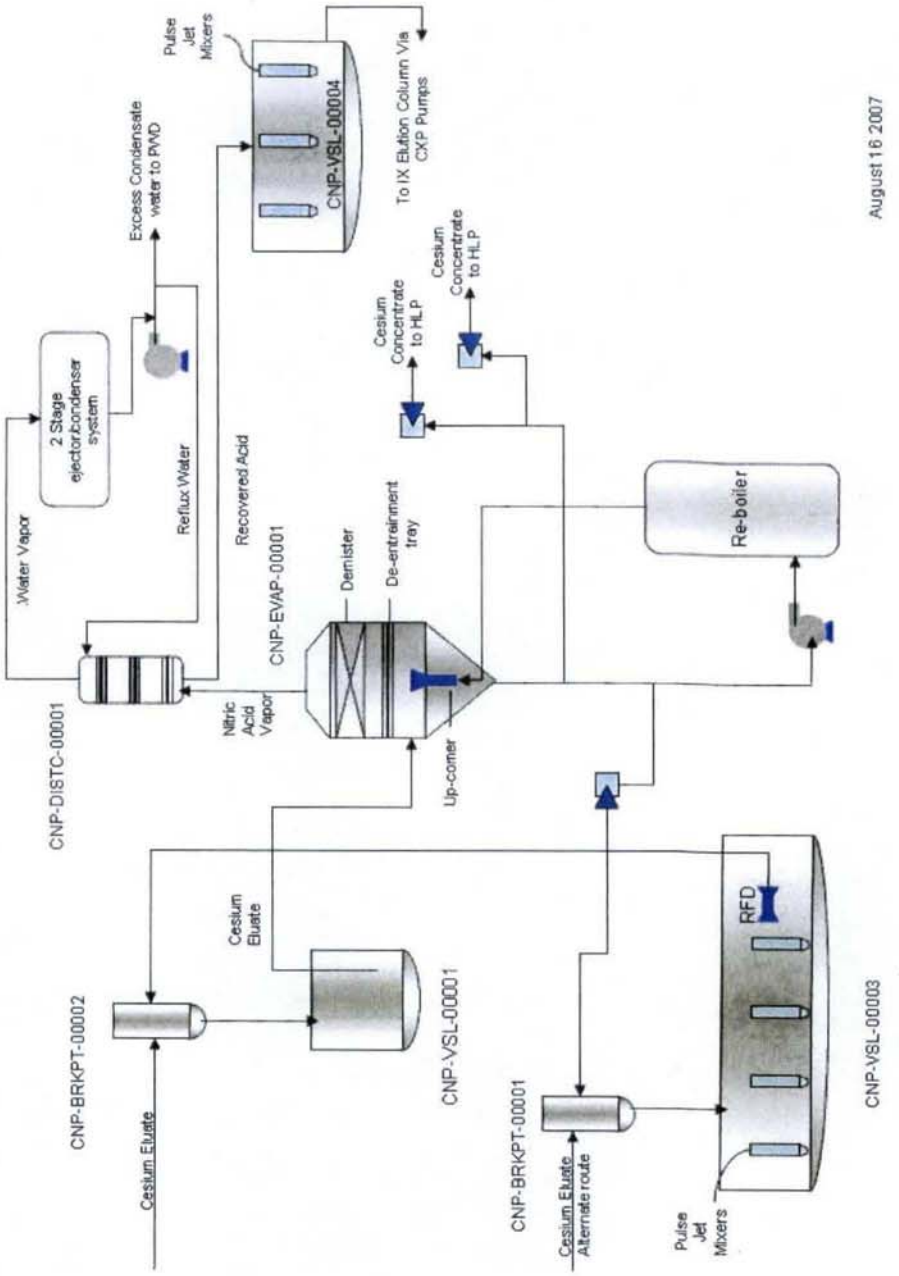
CNP design and operating issues identified by the TRA, which led to a TRL rating of 3, are:

- Lack of prototypical demonstration of an integrated evaporator/rectifier system handling similar feed streams and producing similar products
- CNP operability and instrumentation functionality
- Control of solids precipitation within the evaporator
- Control of entrainment and foaming within the evaporator, and limitation of cesium carryover in recovered nitric acid eluant (system decontamination factor)
- Adequacy of materials of construction to support 40-year operating life
- Maintainability and access needed to support 40-year operating life
- Potential need for caustic neutralization of cesium concentrate prior to transfer to HLW feed

In order to resolve these issues, ORP and BNI are in the process of preparing an IRP. The IRP proposes to resolve the seven issues through equipment modifications or additions to be defined in a CNP closure report that reflects results of a detailed design review (including expert consultant input) and possibly also the results of bench-scale and/or prototypical system tests.

Issue resolution will be based on the use of well-known and established data for physical and thermal properties, vapor-liquid equilibrium, salt solubility, and corrosion rates for nitric acid solutions. Past experience from commercial-scale nitric acid evaporation and rectification operations, including evaporator decontamination factors, will be considered. Vendor input will be solicited. Operation of the current CNP design as an integrated system will be simulated by computer models, including evaluation of the several batch-continuous CXP elution cycles planned within each evaporation cycle. Control and monitoring instrument requirements to ensure steady operation during these cycles will be determined. Adequacy of equipment sizing, vessel surge volumes, entrainment separation, mixing, foam detection and control, salt precipitation control, concentrate transfer ejector system, etc. will be evaluated. Bench-scale and/or prototypical testing may be performed if necessary to resolve design or operability issues.

Figure 2. Block Flow Diagram for the Cesium Nitric Acid Recovery Process System



9.0 OPEN ITEMS AND RECOMMENDATIONS

There are no open items or recommendations. The Assessment Team concluded that the issues associated with the CNP and CXP within their respective black cells are being covered by the technology maturation process. As a result of that process, BNI and DOE are jointly developing IRPs to close issues with respect to the CNP and CXP.

10.0 REFERENCES AND PERSONNEL CONTACTED

10.1 References

07-DESIGN-047, *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility*, draft, U.S. Department of Energy, Richland, Washington, September 2007

24590-PTF-3YD-CXP-00001, *System Description for the Cesium Ion Exchange Process – System CXP*, Rev. 0, Bechtel National Inc., Richland, Washington, September 11, 2002

24590-PTF-MV-CNP-VSL-00003, Rev. 1, *Equipment Assembly Cesium Eluate Breakpot CNP-BRKPT-00002*, April 16, 2007

24590-PTF-MV-CXP-VSL-00001, Rev. 1, *Equipment Assembly Cs IX Vessel – CXP-VSL-0001 (Q)*, draft

24590-PTF-MV-CXP-VSL-00004, Rev. 1, *Conceptual Design of Cesium Ion Exchange Column – CXP-VSL-0001 (Q)*, draft

24590-WTP-3PS-MV00-TP001, *Engineering Specification for Pressure Vessel Design and Fabrication*, Rev. 2, Bechtel National Inc., Richland, Washington, July 12, 2004

24590-WTP-SRD-ESH-01-001-02, *Safety Requirements Document, Volume II*, Rev. 4j, Bechtel National Inc., Richland, Washington, July 17, 2007, Appendix H, "Ad Hoc Implementing Standard for Erosion/Corrosion and Assessments"

DOE/ORP-2007-02, *Technology Maturation Plan – Technology Readiness Assessment Reports for the Waste Treatment and Immobilization Plant Project Facilities*, Volume II, draft, U.S. Department of Energy, Richland, Washington, September 2007

ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Black Cell Access," 04-WED-034, dated July 2, 2004

ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Submittal of U.S. Department of Energy, Office of River Protection (ORP) Design Oversight Report on Black Cell Design Adequacy," 04-WEC-005, dated February 11, 2004

10.2 Personnel Contacted

J. Schneider, Bechtel National, Inc.

APPENDIX A. DESIGN ASSESSMENT PLAN - FOLLOW-ON REVIEW OF WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) PRETREATEMENT (PT) FACILITY VESSEL BLACK CELL DESIGN ADEQUACY OVERSIGHT

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

DESIGN ASSESSMENT PLAN

FOLLOW-ON REVIEW OF WASTE TREATMENT AND IMMOBILIZATION PLANT (WTP) PRETREATEMENT (PT) FACILITY VESSEL BLACK CELL DESIGN ADEQUACY OVERSIGHT

May 14-17, 2007

Design Oversight: D-07-DESIGN-048

Team Lead: Victor L. Callahan, Nuclear Safety, WTP Engineering Division

Team Member: Don Alexander, Chemical Processing, WTP Engineering Division

Team Member: Mike Evarts, ORP Acceptance Inspector, Project Assistance Corporation

Approved:

original signed by
John Eschenberg, Project Manager WTP

May 2, 2007
Date

1.0 OBJECTIVES AND PURPOSE

1.1. BACKGROUND

The U.S. Department of Energy (DOE), Office of River Protection's (ORP) mission is to retrieve and treat Hanford Site 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. In order to meet the requirements of WTP contract, DE-AC27-01RV14136, BNI has constructed black cells in the Pretreatment (PT) Facility. These black cells will contain vessels and piping systems in which no active waste processing occurs. The black cell concept is used in areas where the risk of vessel failure is low to achieve a reduced design capital cost compared to a comparably equipped fully remotely accessible hot cell.

1.2. PURPOSE

The purpose of this assessment is to evaluate a limited follow-on design oversight on the adequacy of PT Facility black cells since the ORP assessment report issued in February 2004[6].

1.3. OBJECTIVES

1. Review black cell design process (as selected by assessment team) for cell(s) to ensure the following:
   - Boundaries on primary drawings and documents
   - Requirements on physical fabrication and construction drawings
   - Requirements in procurement specifications and datasheets
   - Requirements for heating, ventilation, and air conditioning (HVAC) systems and components.
2. Material selection

Evaluate materials selection process and basis for the selection of the vessel and piping material based on:

- Process engineering organization of a mass balance
- Estimation of waste stream chemistry and operating conditions
- Completed material selection datasheets (MSDS)
- Estimation of erosion allowance.

3. Review construction planning, requirements, and methods employed in nondestructive examination (NDE) and evaluation of results.

[6] ORP letter from R. J. Schepens to J. P. Henschel, BNI, "Submittal of U.S. Department of Energy, Office of River Protection (ORP) Design Oversight Report on Black Cell Design Adequacy," 04-WEC-005, dated February 11, 2004.

2.0 SCOPE

The scope of this assessment will include BNI and subcontractor design documents such as, drawings, specifications, calculations, process flow stream data, datasheets, design change documentation, and NDE records.

3.0 PREPARATION

1. Identify ORP assessment team.
2. Notify BNI that ORP will be conducting this design oversight assessment.
3. Identify documents to review, including the results of previous contractor external or internal assessments.
4. Identify contract requirements.
5. Prepare and implement schedule of design oversight assessment activities.

4.0 EVALUATE AND IDENTIFY, RESOLVE, OR DOCUMENT ISSUES

The ORP Design Assessment Team will evaluate BNI documentation in relation to WTP Contract and BNI design requirements. During ORP's evaluation, lines of inquiry (LOI) will be documented and given to BNI's point of contact (POC) for resolution. BNI's responses to LOI questions will be utilized as reference information during the Design Assessment Team's evaluation of the black cell design adequacy.

5.0 REPORTING

The Design Assessment Team Lead will periodically brief ORP management and the Contractor POC during the assessment. The Team Lead, with assistance from the team, will prepare a Design Assessment Report that summarizes review activities, results, and conclusions.

6.0 SCHEDULE OF ACTIVIES

Table 1 lists the schedule of assessment activities.

7.0 DOCUMENTATION

The final report will be formally issued once the draft review comments have been resolved. Any Findings, Assessment Follow-up Items, or Open Issues identified in the report will be assigned a number, and tracked to resolution through Corrective Action Reporting System (CARS) by ORP. These assigned numbers shall also be tracked to resolution by the Contractor through the Correspondence Control Number that will be assigned to the transmittal of the report from ORP to the Contractor.

8.0 CLOSURE

The Assessment team Leader, with concurrence of the WTP Engineering Division (WED) Division Director, shall confirm that Findings, Assessment Follow-up Items, and/or Open Items from this review are adequately resolved.

Table 1. Schedule

Activity Description	Responsibility	Schedule
Develop Design Oversight Plan.	Team Lead	05/01/07
Provide written notification to Contractor of the planned oversight review and include as an attachment the Design Oversight Plan.	Team Lead	05/02/07
Entrance meeting with Contractor personnel to discuss oversight review objectives, scope, schedule, and information requested in Table 1. Initial LOIs will be provided to Contractor at this meeting.	Team	05/14/07
Obtain information items from Contractor.	Team	05/14/07
Review Contractor design documentation, conduct interviews, and perform facility walkdowns as necessary.	Team	05/14/07
Prepare Draft Design Oversight Report.	Team Lead	05/29/07
Resolve comments and issue Final Report including close out with Contractor.	Team	06/28/07

Notes:
(1) Schedule subject to change through Assessment Team Lead.
(2) Team Lead will notify BNI POC of schedule changes as applicable.

Task# ORP-WTP-2007-0262

E-STARS[R] Report
Task Detail Report
10/01/2007 0128

TASK INFORMATION			
Task#	ORP-WTP-2007-0262		
Subject	Concurrence: 07-WTP-262 TRANSMITTAL OF U.S. DEPARTMENT OF ENERGY (DOE), OFFICE OF RIVER PROTECTION (ORP) DESIGN ASSESSMENT REPORT NUMBER D-07-DESIGN-048: DESIGN ASSESSMENT OF PRETREATMENT (PT) FACILITY PROCESS SYSTEMS IN THE CESIUM ION EXCHANGE PROCESS SYSTEM (CXP) AND CESIUM NITRIC ACID RECOVERY PROCESS SYSTEM (CNP) BLACK CELLS		
Parent Task#		**Status**	CLOSED 10/01/2007
Reference	07-WTP-262	**Due**	
Originator	Perez, Anez (Perez, Anez)	**Priority**	High
Originator Phone	(509) 373-0068	**Category**	None
Origination Date	09/21/2007 0741	**Generic1**	
Remote Task#		**Generic2**	
Deliverable	None	**Generic3**	
Class	None	**View Permissions**	Normal
Instructions	bcc: WTP Rdg File WTP Off File MGR Rdg File T. M. Williams, AMD T. Z. Smith, DEP-MGR D. Alexander, WTP V. Callahan, WTP J. R. Eshenberg, WTP P. T. Furlong, WTP J. S. Treadwell, WTP		

ROUTING LISTS		
1	Route List	Inactive
	• Alexander, Donald H - Review - Cancelled - 10/01/2007 1328 *Instructions:*	
	• Treadwell, John S - Review - Cancelled - 10/01/2007 1328 *Instructions:*	
	• Eschenberg, John R - Review - Concur - 09/25/2007 0805 *Instructions:*	
	• Smith, Zack - Review - Concur - 10/01/2007 1039 *Instructions:*	
	• Eschenberg, John R - Approve - Approved - 10/01/2007 1324 *Instructions:*	

ATTACHMENTS

No Attachments

COLLABORATION

COMMENTS

Task# ORP-WTP-2007-0262

No Comments

TASK DUE DATE HISTORY

No Due Date History

SUB TASK HISTORY

No Subtasks

-- end of report --

Task# ORP-WTP-2007-0262

E-STARS[R] Report
Task Detail Report
09/21/2007 0747

TASK INFORMATION			
Task#	ORP-WTP-2007-0262		
Subject	Concurrence: 07-WTP-262 TRANSMITTAL OF U.S. DEPARTMENT OF ENERGY (DOE), OFFICE OF RIVER PROTECTION (ORP) DESIGN ASSESSMENT REPORT NUMBER D-07-DESIGN-048: DESIGN ASSESSMENT OF PRETREATMENT (PT) FACILITY PROCESS SYSTEMS IN THE CESIUM ION EXCHANGE PROCESS SYSTEM (CXP) AND CESIUM NITRIC ACID RECOVERY PROCESS SYSTEM (CNP) BLACK CELLS		
Parent Task#		**Status**	Open
Reference	07-WTP-262	**Due**	
Originator	Perez, Anez (Perez, Anez)	**Priority**	High
Originator Phone	(509) 373-0068	**Category**	None
Origination Date	09/21/2007 0741	**Generic1**	
Remote Task#		**Generic2**	
Deliverable	None	**Generic3**	
Class	None	**View Permissions**	Normal
Instructions	bcc: WTP Rdg File WTP Off File MGR Rdg File T. M. Williams, AMD T. Z. Smith, DEP-MGR D. Alexander, WTP V. Callahan, WTP J. R. Eshenberg, WTP P. T. Furlong, WTP J. S. Treadwell, WTP		

ROUTING LISTS

1	Route List	Active
	• Alexander, Donald H - Review - Awaiting Response - Due Date 9/21/07 *Instructions:*	
	• ~~Treadwell, John S~~ Griffith, Bob - Review - ~~Awaiting Response - Due Date~~ 9/21/07 *Instructions:*	
	• Eschenberg, John R - Review - Awaiting Response - Due Date *Instructions:* 9/24 OK w/ comment resolution	
	• Smith, Zack - Review - Awaiting Response - Due Date *Instructions:* 9/25 10/01/07	
	• Eschenberg, John R - Approve - Awaiting Response - Due Date *Instructions:*	

Received 9/21/07

Received 10/01/07

ATTACHMENTS

No Attachments

COLLABORATION

COMMENTS

Task# ORP-WTP-2007-0262

No Comments

TASK DUE DATE HISTORY

No Due Date History

SUB TASK HISTORY

No Subtasks

-- end of report --