Bechtel National, Inc.

Job No. 24590

**SUPPLIER DOCUMENT STATUS**

1. [X] **Work may proceed.**
2. [ ] **Revise and resubmit. Work may proceed subject to resolution of indicated comments.**
3. [ ] **Revise and resubmit. Work may not proceed.**
4. [ ] **Review not required. Work may proceed.**

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

| REVIEWED | | | | | | | | | EGPS 8/4 |
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G-321 Document Category N/A
[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

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[When applicable]

416 GP&S 7-03

# 24590-CM-HC4-HXYG-00138-02-00033

# REV. 00A

## SUBCONTRACT SUBMITTAL

Best Available Copy

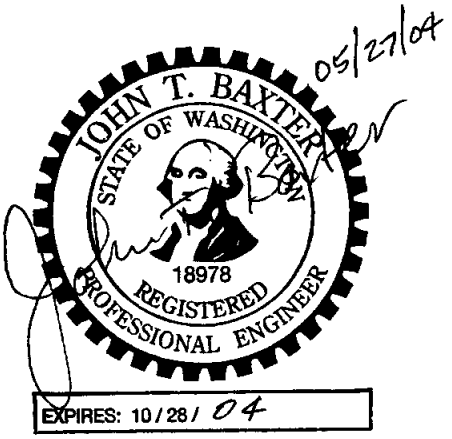
# IQRPE REVIEW - PRETREATMENT FACILITY (PTF) CESIUM ION EXCHANGE PROCESS – SYSTEM (CXP) VESSELS

"I, John T. Baxter have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the Pretreatment Facility (PTF) Cesium Ion Exchange Process – System (CXP) Vessels as required by The Dangerous Waste Regulations, namely, WAC 173-303-640(3) applicable paragraphs, i.e., (a) through (g)."

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

The documentation reviewed indicate that the design intent fully satisfies the requirements of the WAC.

The attached review is seven (7) pages numbered one (1) through seven (7).




24590-CM-HC4-HXYG-00138-02-00033, REV.00A

John T. Baxter
Signature

05/27/2004
Date

# STRUCTURAL INTEGRITY ASSESSMENT OF THE PRETREATMENT FACILITY (PTF) CESIUM ION EXCHANGE PROCESS - SYSTEM (CXP) VESSELS

**COGEMA-IA-058**
**Rev. 0**

**Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.**

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| **Scope** | Scope of this Integrity Assessment | The scope of this integrity assessment includes the Pretreatment Facility (PTF) Cesium (Cs) Ion Exchange (IX) Process – System CXP Vessels. The Vessels are; Cs IX Vessel CXP-VSL-00001, Caustic Rinse Collection Vessel CXP-VSL-00004, Cs Reagent Vessel CXP-VSL-00005 and Cesium Ion Exchange Treated LAW Collection Vessels CXP-VSL-00026A/B/C. The primary function of the CXP System including the vessels is to remove cesium from filtered process liquor to prepare it for treatment in the low activity waste (LAW) melters. |
| **References** | Material Requisitions, Drawings, Data Sheets, Specifications and System Description | Material Requisition No: 24590-QL-MRB-MVA0-00001, Rev. 3, Pressure Vessels, High Alloy Shop Fabricated Large, QL-1 (VXLA), MR Section 2 – Technical Specifications (Rev. 0, May 2002);<br>Material Requisition Supplement 24590-QL-MRB-MVA0-00001-S01, S02, S03, S04, S05, S0006 & S0007 to MR No. 24590-QL-MRB-MVA0-00001, Rev. 3;<br>Material Requisition No: 24590-QL-MRA-MVA0-00006, Rev. 1, Pressure Vessels, High Alloy Shop Fabricated Large, QL-1 (N141)(MS076), MR Section 2 – Technical Specifications (Rev. 5, August 19, 2003);<br>Material Requisition Supplement 24590-QL-MRA-MVA0-00006-S0001 to MR No: 24590-QL-MRA-MVA0-00006, Rev. 1;<br>Material Requisition No: 24590-QL-MRC-MVA0-A0002, Rev. 0, Pressure Vessels, High Alloy Or Clad, MR Section 2 – Technical Specifications (Rev. 4, April 10, 2003);<br>Material Requisition Supplement 24590-QL-MRC-MVA0-A0002-S0001 & -S0004 to MR No: 24590-QL-MRC-MVA0-A0002, Rev. 0;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00007, Rev. 1, Cs IX Feed Vessel CXP-VSL-00001;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00015, Rev. 1, Cs, IX, Caustic Rinse Collection Vessel CXP-VSL-00004;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00016, Rev. 2, Cs Reagent Vessel CXP-VSL-00005;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00021, Rev. 1, Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026A;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00022, Rev. 1, Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026B;<br>Mechanical Data Sheet: Vessel 24590-PTF-MVD-CXP-00023, Rev. 1, Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026C; |

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| **References** | Material Requisitions, Drawings, Data Sheets, Specifications and System Description | Plant Item Material Selection Data Sheet 24590-PTF-N1D-CXP-P0001, Rev. 0, Cs Ion Exchange Feed Vessel CXP-VSL-00001 (PTF);<br>Plant Item Material Selection Data Sheet 24590-PTF-N1D-CXP-P0007, Rev. 0, Cs IX Caustic Rinse Collection Vessel CXP-VSL-00004 (PTF);<br>Plant Item Material Selection Data Sheet 24590-PTF-N1D-CXP-P0008, Rev. 0, Cs IX Reagent Vessel CXP-VSL-00005 (PTF);<br>Plant Item Material Selection Data Sheet 24590-PTF-N1D-CXP-P0003, Rev. 0, IX Treated LAW Collection Vessel CXP-VSL-00026A/B/C (PTF);<br>24590-PTF-P1-P01T-P0001, Rev. 3, Pretreatment Facility General Arrangement Plan @ EL. 0'-0";<br>24590-PTF-MV-CXP-00001, Rev. 0, Equipment Assembly Cs IX Vessel CXP-VSL-00001 (Q);<br>24590-PTF-MV-CXP-00002, Rev. 0, Equipment Assembly Caustic Rinse Collection Vessel CXP-VSL-00004 (Q);<br>24590-PTF-MV-CXP-00003, Rev. 1, Equipment Assembly Cesium Reagent Vessel CXP-VSL-00005;<br>24590-PTF-MV-CXP-00008, Rev. 0, Equipment Assembly Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026A;<br>24590-PTF-MV-CXP-00009, Rev. 0, Equipment Assembly Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026B;<br>24590-PTF-MV-CXP-00010, Rev. 0, Equipment Assembly Cesium Ion Exchange Treated LAW Collection Vessel CXP-VSL-00026C;<br>24590-PTF-3YD-CXP-00001, Rev. 0, System Description for the Cesium Ion Exchange Process – System CXP;<br>SDCN No. 24590-PTF-3YN-CXP-00002 for System Description No. 24590-PTF-3YD-CXP-00001, Rev. 0 |

**Summary of Assessment**

For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to assure the design intent fully satisfies the WAC requirements.

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| Design | Vessel design standards are appropriate and adequate for the vessel's intended use. | Drawings, Material Requisitions and Mechanical Data Sheets listed above under References;<br>24590-WTP-3PS-MV00-T0001, Rev. 0, Engineering Specification for Pressure Vessel Design and Fabrication (CXP-VSL-00001, CXP-VSL-00004)(Rev. 1, CXP-VSL-00026A/B/C );<br>SCN No. 24590-WTP-3PN-MV00-00006 for Specification No. 24590-WTP-3PS-MV00-T0001, Rev. 1;<br>24590-WTP-3PS-MV00-T0003, Rev. 1, Engineering Specification for Pressure Vessel Fatigue Analysis;<br>ASME Boiler and Pressure Vessel Code (B&PV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers;<br>ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Alternative Rules, American Society of Mechanical Engineers | The Material Requisitions require use of The Engineering Specification for Pressure Vessel Design and Fabrication for vessels CXP-VSL-00001, CXP-VSL-00004, CXP-VSL-00005 and CXP-VSL-00026A/B/C. This specification requires that the vessels and all vessel appurtenances are to be designed to ASME B&PV Code, Section VIII, Division 1 rules. Additional supplementary requirements are specified in the specifications for Pressure Vessel Design and Fabrication. These supplementary requirements address pressure vessel fatigue analysis, positive material identification, standard fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, quality assurance requirements, and packaging, shipping, handling and storage requirements. Some of the vessels' internal equipment is subject to cyclic loading, e.g., pulse jet mixers and charge vessels. The Engineering Specification for Pressure Vessel Fatigue Analysis requires use of the fatigue design standards in ASME B&PV Code, Section VIII, Division 2, which are appropriate for components with a high number of load cycles. The Mechanical Data Sheets identify the CXP vessels as Quality Level (QL-1) and Seismic Category (SC-I) equipment. These quality level and seismic category classifications are discussed in the Engineering Specification for Pressure Vessel Design and Fabrication. These are adequate and acceptable codes and standards for design and fabrication of these CXP system columns and vessels. |
| | If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction. | 24590-WTP-3PS-MV00-T0001, Rev. 0, Engineering Specification for Pressure Vessel Design and Fabrication (CXP-VSL-00001, CXP-VSL-00004)(Rev. 1, CXP-VSL-00026A/B/C );<br>SCN No. 24590-WTP-3PN-MV00-00006 for Specification No. 24590-WTP-3PS-MV00-T0001, Rev. 1; | The Engineering Specifications for Pressure Vessel Design and Fabrication require that the CXP system vessels are to be designed and fabricated in accordance with the requirements of ASME Section VIII, Division 1. The vessels are to be delivered after design, fabrication, inspection and testing with an ASME code stamp and they will be registered with the National Board. These are shop fabricated vessels for mixed waste service in the PTF. The design standards are appropriate and adequate for the equipments' intended uses. |

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| **Design** | Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads. | Drawings, Material Requisitions and Mechanical Data Sheets listed above under References;<br>24590-WTP-3PS-MV00-T0001, Rev. 0, Engineering Specification for Pressure Vessel Design and Fabrication (CXP-VSL-00001, CXP-VSL-00004)(Rev. 1, CXP-VSL-00026A/B/C );<br>SCN No. 24590-WTP-3PN-MV00-00006 for Specification No. 24590-WTP-3PS-MV00-T0001, Rev. 1;<br>24590-WTP-3PS-MV00-T0002, Rev. 1, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels;<br>24590-WTP-3PS-SS90-T0001, Rev. 0, Engineering Specification for Seismic Qualification of Seismic Category I and II Equipment and Tanks;<br>ASME Section VIII, Division 1, Rules for Construction of Pressure Vessels, Division 2, Alternative Rules, American Society of Mechanical Engineers | The Engineering Specification for Pressure Vessel Design and Fabrication requires that the CXP vessels are to be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria for Pressure Vessels and Seismic Qualification of Seismic Category I and II Equipment and Tanks and to provide for the seismic design analysis. The Mechanical Data Sheets identify the operating pressure and temperature ranges for each vessel, the materials selected in the corrosion report, the corrosion allowance, and the requirements for seismic qualification in the design. The Mechanical Data Sheets indicate that the CXP vessels are to be analyzed as Seismic Category (SC-I) vessels which requires use of the supplementary seismic design requirements from ASME Section VIII, Division 2. These are adequate and appropriate codes and criteria to ensure the vessels have adequate strength at the end of their design lives. |
| **Foundation** | Vessel foundation will maintain the load of a full vessel. | Drawings and System Description listed above under References;<br>24590-WTP-3PS-MV00-T0001, Rev. 0, Engineering Specification for Pressure Vessel Design and Fabrication (CXP-VSL-00001, CXP-VSL-00004)(Rev. 1, CXP-VSL-00026A/B/C );<br>SCN No. 24590-WTP-3PN-MV00-00006 for Specification No. 24590-WTP-3PS-MV00-T0001, Rev. 1 | The Equipment Assembly drawings show the support arrangements for the CXP system vessels. Most of the CXP system vessels are provided with cylindrical skirts and a ring beam to provide for bearing on concrete and anchorage. The Cs Reagent Vessel, CXP-VSL-00005 is provided with four lug supports spaced 90 degrees apart on the shell. This vessel will be supported on the local floor structure at elevation 56'-0" as discussed in the System Description. The Engineering Specifications for Pressure Vessel Design and Fabrication requirements assure adequate vessel foundation designs for both skirts and support lugs. These codes and standards are adequate to assure that the vessel and column foundations will maintain the loads when the equipment is full. |

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| **Foundation** | If in an area subject to flooding, the vessel is anchored. | 24590-WTP-3PS-MV00-T0001, Rev. 0, Engineering Specification for Pressure Vessel Design and Fabrication (CXP-VSL-00001, CXP-VSL-00004)(Rev. 1, CXP-VSL-00026A/B/C ); SCN No. 24590-WTP-3PN-MV00-00006 for Specification No. 24590-WTP-3PS-MV00-T0001, Rev. 1 | The CXP system vessels are to be designed in accordance with the Engineering Specification for Pressure Vessel Design and Fabrication. Buoyant forces of an empty vessel in a flooded room are a mandatory standard design load case in this specification. |
| **Frost Heave** | Vessel system will withstand the effects of frost heave. | Drawings and System Description listed above under References<br>24590-WTP-DC-ST-01-001, Rev. 2, Structural Design Criteria | The PTF General Arrangement Plan at elevation 0'-0" shows that the CXP system vessels are installed in inaccessible process cells with the exception of the Cs Reagent Vessel, CXP-VSL-00005, which is supported on the floor structure at elevation 56'-0". These cells and floors are supported by the PTF mat foundation. The Structural Design Criteria requires that all structural foundations extend into the surrounding soil below the frost line in order to preclude frost heave. The frost line is located 30 in. below finished grade. The PTF mat foundation is not subject to frost heave; therefore, the CXP system vessels will not be subject to frost heave. |
| **Waste Characteristics** | Characteristics of the waste to be stored or treated have been identified (ignitable, reactive, toxic, specific gravity, vapor pressure, flash point, storage temperature) | Drawings, Mechanical Data Sheets and System Description listed above under References; 24590-WTP-PSAR-ESH-01-002-02, Rev. 1a, Preliminary Safety Analysis Report (PSAR) to Support Construction Authorization; PT Facility Specific Information | The System Description identifies that the CXP system processes filtered LAW waste feed with a sodium concentration of about 5 M and a pH of about 13. The Cs IX Feed Vessel (CXP-VSL-00001) and the Cs Reagent Vessel (CXP-VSL-00005) must function to provide primary containment of the waste during normal and abnormal operations, and during and after a design basis earthquake. Primary containment is required to protect the facility workers, co-located workers and the public from exposure to radiation and toxic waste hazards of the tank contents. These items must also retain integrity during all operating conditions to allow the hydrogen purge, dilution and mixing systems to function and maintain hydrogen concentrations in the vessel head spaces below flammability limits as discussed in the PSAR. The Cs IX Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) and the Caustic Rinse Collection Vessel (CXP-VSL-00004) function to provide primary containment of the waste during normal and abnormal operations, and during and after a design basis earthquake. These tanks are not a concern for hydrogen control. All vessels are equipped with internal spray rings for decontamination. |

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| Waste Characteristics | Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents. | Plant Item Material Selection Data Sheets, Mechanical Data Sheets and System Description listed above under References | The Plant Item Material Selection Data Sheets show that the materials selected for the CXP system vessels take into account the chemistry of the waste and the reagents processed in these equipment items. With two exceptions, all CXP system vessels considered herein are to be constructed using 316 stainless steel (max. 0.030% carbon, dual certified) hereinafter referred to as 316L stainless steel. Vessels (CXP-VSL-00004 & -00005) are to be fabricated from 304 stainless steel (max. 0.030% carbon, dual certified) hereinafter referred to as 304L stainless steel. |
| | The waste types are compatible with each other. | System Description listed above under References | The system description describes the CXP system operations. During normal ion exchange operations, filtered LAW feed at a pH of about 13 is pumped from the Cs IX Feed Vessel (CXP-VSL-00001) through the Cs IX columns to the Cs IX Treated LAW Collection Vessels (CXP-VSL-00026A/B/C). During these operations, the cesium is stripped from the LAW feed and deposited on the IX resins. The elution process that is used to strip the cesium from the IX resins consists of dilute caustic and demineralized water rinses and the elution sequence using 0.5 M nitric acid. The Cs Reagent Vessel (CXP-VSL-00005) receives similar dilute caustic and nitric acid streams during normal operations. These processes are discussed in the System Description. Caustic rinse liquids are recycled and returned to the Cs IX feed tank. Acid elutants are transferred to the CNP system. Incompatible wastes are separated during normal operations. |
| Compatibility | Vessel material and protective coatings ensure the vessel structure is adequately protected form the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system) | Plant Item Material Selection Data Sheets, Mechanical Data Sheets and System Description listed above under References | The Plant Item Material Selection Data Sheets show that the materials selected for the CXP system vessels take into account the chemistry of the waste and the reagents processed in these equipment items. With two exceptions, all CXP system columns and vessels are to be constructed using 316L stainless steel. Vessels (CXP-VSL-00004 & -00005) are to be fabricated from 304L stainless steel.<br>These material selections are correctly carried forward to the column and vessel Mechanical Data Sheets. The materials selected are adequate to provide the required 40 year service life for these vessels. |

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| **Corrosion Allowance** | Corrosion allowance is adequate for the intended service life of the vessel. | Plant Item Material Selection Data Sheets, Drawings and Mechanical Data Sheets listed above under References;<br>24590-PTF-3PS-MWD0-T0005, Rev. 0, Engineering Specification for Cesium Ion Exchange Columns | The Plant Item Material Selection Data Sheets list the following corrosion allowances for the CXP system vessels:<br>CXP-VSL-00001, 316L stainless steel, 0.040 in. for 40 years;<br>CXP-VSL-00004 & -00005, 304L stainless steel, 0.040 in. for 40 years;<br>CXP-VSL-00026A/B/C, 316L stainless steel, 0.040 in. for 40 years.<br>These material selections and corrosion allowances assure an adequate service life for the vessels. |
| **Pressure Controls** | Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded. | Drawings and System Description listed above under References | The Equipment Assembly drawings show that the CXP system vessel overflow lines are larger than any of the other liquid conveying lines entering the vessels and therefore have adequate flow capacity to preclude overpressure. |