Job No. 24590

Bechtel National, Inc.

**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 | | | | | | | | | | |
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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]

Supersedes BNI Document No. 24590-CM-HC4-HXYG-00138-01-15 Rev. 00A
[When applicable]

Accepted by _____ Print Name _____ Signature _____ Date 1/20/04

Released by N/A Print Name _____ Signature _____ Date _____
[When applicable]

416 GP&S 7-03

# 24590-CM-HC4-HXYG-00138-01-15
# REV. 00B

SUBCONTRACT SUBMITTAL

COGEMA ENGINEERING

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JAN 12 2004
BNI-Subcontracts

January 9, 2004

COGEMA-04-0003

D. J. Whiting
Bechtel National, Inc.
Waste Treatment Plant
2435 Stevens Center
Richland, Washington 99352

Dear Ms. Whiting:

**STRUCTURAL INTEGRITY ASSESSMENT OF THE WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1**

The integrity assessment has been completed per the contract requirements and is attached for your use. The assessment found the design intent is sufficient to ensure the WTP Below Grade Waste Transfer Lines (Secondary Containment and Ancillary Equipment) will be adequately designed and that the WTP Below Grade Waste Transfer Lines (Secondary Containment and Ancillary Equipment) will have sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that they will not collapse, rupture, or fail.

If you have any questions, please contact me at (509) 376-5445, or via facsimile at (509) 372-0504.

Sincerely,

K. V. Scott, Manager
Facilities, Structures & Components

kld

Attachment

cc: D. C. Pfluger MS4-E2 w/ attachment

2425 Stevens Center Place, Second Floor, Richland, Washington 99352 Tel: (509) 372-3572 - Fax: (509) 372-3169
COGEMA Engineering Corporation

R10190664

# IQRPE REVIEW – WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1

"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 WTP Below Grade Waste Transfer Lines (Secondary Containment, Ancillary Equipment, and Corrosion Assessment) 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 10 sheets numbered 1 through 10.

JOHN T. BAXTER
STATE OF WASHINGTON
18978
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 10/28/04

John T. Baxter

Signature

Date 01/09/2004

RPP-WTP
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JAN 13 2004
BY PDC

24590-CM-HC4-HXYG-00138-01-15 Rev.00B

# STRUCTURAL INTEGRITY ASSESSMENT OF THE WTP BELOW GRADE WASTE TRANSFER LINES (SECONDARY CONTAINMENT, ANCILLARY EQUIPMENT, AND CORROSION ASSESSMENT), REVISION 1

## COGEMA-IA-015
## REV. 1

**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.**

| | | |
|---|---|---|
| **Scope** | Scope of this Integrity Assessment | This integrity assessment addresses the WTP Below Grade Waste Transfer Lines shown on Plant Wash & Disposal System Underground Transfer Lines P&ID drawings 24590-PTF-M6-PWD-P0057 and 24590-PTF-M6-PWD-P0058 (exclusive of the RLD lines shown as "on hold" on drawing –P0058). It considers the ancillary equipment, secondary containment, and a corrosion assessment for each of these transfer lines. The interfacility portion of these lines are direct buried double-walled pipe transfer lines. These transfer lines are associated with several process systems.<br>Independent Corrosion Expert (ICE) Report: Attachment A, Corrosion Integrity Assessment of Waste Transfer Pipelines in the Hanford Waste Treatment Plant, Corrosion Control Specialists, Kent, Washington, Dennis P. Helgeson, P.E., 4 pages, 08/11/03.<br>Attachment B, Buried Pipeline and Ancillary Equipment vs Soil Environment Compatibility Report, Ibid., 6 pages, 08//11/03. |

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| **References** | Drawings | 24590-PTF-M6-PWD-P0057, Rev. 0, P&ID PLANT WASH & DISPOSAL SYSTEM UNDERGROUND TRANSFER LINES (Q);<br>24590-PTF-M6-PWD-P0058, Rev. 0, P&ID-PTF PLANT WASH & DISPOSAL SYSTEM UNDERGROUND TRANSFER LINES (Q);<br>24590-PTF-M6-PWD-P0002, Rev. 1, P&ID-PTF PLANT WASH & DISPOSAL SYSTEM EFFLUENT COLLECTION PWD-VSL-00033/00043/00044 (Q);<br>24590-HLW-M6-HCP-P0001, Rev. 0, P&ID-HLW Concentrate Receipt Process System Concentrate Receipt Vessel 1 (Q);<br>24590-HLW-M6-HCP-P0002, Rev. 0, P&ID-HLW Concentrate Receipt Process System Concentrate Receipt Vessel 2 (Q);<br>24590-HLW-M6-RLD-P0001, Rev. 0, P&ID-HLW Radioactive Liquid Waste Disposal System Active Effluent Collection (Q);<br>24590-HLW-M6-RLD-P0002, Rev. 0, P&ID-HLW Radioactive Liquid Waste Disposal System Plant Wash and Drains Vessel (Q);<br>24590-WTP-M6-50-P0001, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 1 OF 6;<br>24590-WTP-M6-50-P0002, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 2 OF 6;<br>24590-WTP-M6-50-P0003, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 3 OF 6;<br>24590-WTP-M6-50-P0004, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 4 OF 6;<br>24590-WTP-M6-50-P0005, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 5 OF 6;<br>24590-WTP-M6-50-P0006, Rev. 0, P&ID SYMBOLS AND LEGEND SHEET 6 OF 6 |

**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.

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Design** | Ancillary equipment design standards are appropriate and adequate for the equipment's intended use. | 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria";<br>24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description;<br>24590-WTP-3PS-PS02-T0001, Rev. 2, Engineering Specification for Shop Fabrication of Piping;<br>24590-WTP-3PN-PS-02-00008, Specification Change Notice to 24590-WTP-3PS-PS02-T0001, Rev. 2;<br>24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q);<br>24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q) | The Pipe Stress Design Criteria document identifies American Society of Mechanical Engineers (ASME) B31.3 Process Piping as the design code for both safety grade and commercial grade piping systems of the WTP. To satisfy more stringent seismic requirements, the design criteria includes methodology provided in the ASME Boiler & Pressure Vessel Code, Section III Rules for Construction of Nuclear Facility Components (ASME Section III) to supplement the design rules of ASME B31.3 code for analysis and design of safety grade piping. The Piping Material Class Description document identifies the design conditions including limiting pressure and temperature service conditions and the corrosion/erosion allowance for each Piping Material Class, the piping material and wall thickness, and the appropriate design code(s). The description for each class identifies the ancillary equipment requirements for pipe, fittings, flanges, valves, and gaskets for the service conditions in which they will be employed. The Material Classes for the transfer lines being considered are W62F, S32B, W31A, and W32A. All of the transfer lines considered here are double-walled pipe containing a 3 in. nominal pipe size stainless steel carrier pipe inside a 6 in. nominal pipe size carbon steel seamless encasement pipe. The transfer lines are identified on the P&ID drawings as Quality Level (QL-1) and Seismic Category (SC-1). These codes and standards are acceptable and adequate for the design of the double-walled transfer lines. |
| | If the ancillary equipment to be used is not built to a design standard, the design calculations demonstrate sound engineering principles of construction. | 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria" | This item is Not Applicable because the ancillary equipment piping is to be designed in accordance with ASME B31.3 for all applicable load conditions and load combinations as noted above. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Design** | Ancillary equipment has adequate strength at the end of its design life to withstand the operating pressure, operating temperature, thermal expansion, and seismic loads. Equipment is protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction. | 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria";<br>24590-WTP-PER-M-02-002, Rev 0, Materials for Ancillary Equipment<br>24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description;<br>ME101, Linear Elastic Analysis of Piping, Version N6 software, Bechtel Corporation, Computer Services Library, 50 Beale St., San Francisco, California;<br>24590-WTP-VV-PS-01-001, Rev 1, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping Version N6 | The Pipe Stress Design Criteria document specifies the ASME B31.3 code to address operating pressure, operating temperature, thermal expansion/contraction, settlement or support displacements, corrosion, and vibration and seismic loads. Elements of the ASME B&PV Code, Section III (Subsection NC and Appendices F and N) are used to supplement the requirements of ASME B31.3 for seismic design of Seismic Category (SC-I/II) ancillary equipment. Details of the seismic design methods are discussed in the Pipe Stress Design Criteria document. The ME101Linear Elastic Analysis of Piping program is used for static and dynamic design analysis for the more complex ancillary equipment such as the underground transfer lines. The program has been verified and validated. The Piping Material Class Description document provides enveloping values for design pressure and temperature limits for the primary carrier pipes and the secondary encasement pipes for each pipe class. A bounding corrosion/erosion allowance is furnished for the primary pipe for each class. These codes and standards are adequate and appropriate to assure that the ancillary equipment has adequate strength at the end of design life. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Supports** | Ancillary equipment supports are adequately designed. | 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design;<br>24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria";<br>ME101, Linear Elastic Analysis of Piping, Version N6 software, Bechtel Corporation, Computer Services Library, 50 Beale St., San Francisco, California;<br>24590-WTP-VV-PS-01-001, Rev 1, Verification and Validation Report for ME101, Linear Elastic Analysis of Piping Version N6 | Pipe supports for the primary transfer line inside the secondary containment pipe consist of small support plates and spacers installed between the exterior surface of the primary pipe and the inside surface of the secondary containment pipe. A standard set of typical details is provided in the Ancillary Equipment Pipe Support Design document. An adequate set of horizontal supports, guides, and pipe anchor typical details is furnished to the fabricator to allow production of the spools. Additional details are furnished for closure of encasements at field connections, installation of insulation with an outer wrapping and elbow assemblies. The final design evaluations for the pipe-in-pipe transfer lines will be accomplished with ME101 models that represent the primary and secondary pipes, internal supports, guides and anchors, the surrounding soil, and the final line routings (geometries). The Pipe Stress Design Criteria document is organized around the design requirements of ASME B31.3 Process Piping supplemented by ASME Section III, Division 1, Subsection NC and Appendices F and N requirements for seismic design analysis. For safety grade supports, design allowable stresses are based on allowables for normal loads as defined in ASME Section III, Division I. Analysis is by manual calculation or approved computer programs. These codes and standards are appropriate and adequate for mixed waste transfer lines over the range of conditions identified for these systems. Use of approved and validated computer programs to analyze piping designs is appropriate. |
| **Connections** | Seams and connections are adequately designed. | 24590-WTP-PER-PS-02-001, Rev. 4, Ancillary Equipment Pipe Support Design;<br>24590-WTP-3PS-PS02-T0001, Rev. 2, Engineering Specification for Shop Fabrication of Piping;<br>24590-WTP-3PN-PS-02-00008, Specification Change Notice to 24590-WTP-3PS-PS02-T0001, Rev. 2 | The Engineering Specification for Shop Fabrication of Piping shows that the double-walled transfer lines use welded butt joints for all connections. The transfer lines are Quality Level 1 (QL-1). Welding requirements are in accordance with ASME B31.3. Welder qualifications are in accordance with the ASME Boiler and Pressure Vessel Code (B&PV) Section IX, Welding and Brazing Qualifications. Nondestructive examinations are to be conducted in accordance with ASME B&PV Section V as specified in the Engineering Specification for Shop Fabrication of Piping, Appendix A. The Ancillary Equipment Pipe Support Design document shows examples of standard assemblies for the transfer lines and encasements. These are adequate and appropriate design and fabrication codes and standards for the ancillary equipment being evaluated. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Frost Heave** | The system will withstand the effects of frost heave. | 24590-WTP-DC-ST-01-001, Rev. 1, Structural Design Criteria;<br>24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design | The Structural Design Criteria identifies the frost line as being 30 in. below grade. The Civil, Structural, Architectural Basis of Design section requires that all underground pipes be installed with the top of pipe at least 30 in. below grade so that the pipes are not 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, temperature) | 24590-WTP-PSAR-ESH-01-002-02, Rev. 1, Preliminary Safety Analysis Report to Support Construction Authorization; PT Facility Specific Information;<br>24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design;<br>24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection;<br>24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description | Chapter 4 of the Preliminary Safety Analysis Report identifies the Important to Safety functions for the waste transfer lines. They are listed as maintaining structural integrity for their design life while resisting a high radiation environment, corrosive effects of the process streams, and the erosive nature of the suspended solids. In addition, the waste transfer lines must maintain structural integrity during and after a seismic event. The Underground Pipe Protection document and the Piping Material Class Description document provide the basis for the corrosion/erosion allowances and list the allowances for each pipe class. Flammable gas is not identified as a concern for the waste transfer lines. Transfer lines originating or terminating in source or downstream receiving tanks typically include a dip tube that terminates below the surface of the low level heel in each tank. The dip tubes isolate the lines from any potential flammable gas buildup in the tank vapor spaces. The Basis of Design document requires a facility wide grounding system to be in place, including process equipment, to control ignition sources. The design has included adequate and appropriate features to address the waste characteristics including pressure, temperature, corrosion, erosion and control of potential flammable gases in ancillary equipment. |

| | Information Assessed | Source of Information | Discussion |
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| **Waste Characteristics** | Ancillary equipment is designed to handle the wastes with the characteristics defined above and any treatment reagents. | 24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design;<br>24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection | The Basis of Design requires that dangerous waste tank systems meet the requirements of WAC 173-303-640. The Underground Pipe Protection document discusses the rationale for material selection for the underground transfer lines. The primary lines from the Hanford Tank Farms are 304L stainless steel because they are used to transfer alkaline wastes to the WTP. The intraplant transfer lines in the WTP use primary lines of 316L stainless steel to provide for transferring less alkaline solutions. The primary pipelines will be flushed with inhibited water after each use for corrosion control. Carbon steel was selected for the secondary encasement lines. During normal operations, the annulus between the exterior of the primary pipelines and the interior of the encasement lines remains dry which limits corrosion. The carbon steel encasement lines have sufficient wall thickness to resist internal corrosion from a waste leak for a period of time adequate to detect the leak and allow for flushing of the secondary line. The exteriors of the secondary encasements for the intraplant transfer lines are protected with a cathodic protection system. The exteriors of the secondary encasements for the transfer lines from the Hanford Tank Farms are enclosed in closed-cell bonded foam insulation with a waterproof outer jacket of High Density Polyethylene to prevent exterior corrosion. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Compatibility** | The pH range of the waste, waste temperature and the corrosion behavior of the structural materials are adequately addressed. Ancillary equipment material and protective coatings ensure the ancillary equipment structure is adequately protected from the corrosive effects of the waste stream and external environments. The protection is sufficient to ensure the equipment will not leak or fail for the design life of the system. | See drawings listed above;<br>24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection;<br>24590-WTP-3YD-CPE-00001, Rev. C, System Description for Cathodic Protection;<br>24590-WTP-3PS-EQ00-T0002, Rev. 2, Engineering Specification for Cathodic Protection;<br>Specification No. 24590-WTP-3PS-PX04-T0004, Rev. 0, Engineering Specification for Epoxy Coating of Stainless Steel Items that are Buried, Embedded or Insulated;<br>Specification No. 24590-WTP-3PS-PX04-T0001, Rev. 0, Engineering Specification for Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe;<br>Requisition Number: 24590-QL-MRA-PSO2-00008, Rev. 2, SECTION 2 - TECHNICAL SPECIFICATIONS | The Underground Pipe Protection report identifies that two grades of stainless steel have been selected for the underground transfer lines. The primary transfer lines from the Hanford Tank Farms are 304L stainless steel because they are used to transfer alkaline wastes to the WTP. The intraplant transfer lines in the WTP use primary lines of 316L stainless steel to provide for transferring less alkaline solutions. All primary transfer lines are to be flushed with inhibited water after each use. Secondary encasement lines are designed to be sufficiently internally corrosion resistant to provide leak protection from the time a primary leak starts until the leak has been detected and the transfer line has been isolated. The soil side of the secondary encasement lines is to be protected with cathodic protection in accordance with National Association of Corrosion Engineers (NACE) International Recommended Practices (except for the Waste Feed Receipt Process System transfer lines). A System Description document identifies the overall scope of the WTP Cathodic Protection System that will be applied to the waste transfer lines. Detailed specifications for design and construction are furnished in the Engineering Specification for Cathodic Protection. Transfer lines evaluated in this integrity assessment have carbon steel secondary encasements. An impressed current cathodic protection system is to be used to protect these secondaries from corrosion where they are buried. The specification for "Shop Applied Fusion Bonded Epoxy Coating" describes the epoxy coating that will be applied to the outside of the transfer lines to control current flow in the cathodic protection system. Consideration was given to service life and cumulative anticipated radiation exposure of candidate epoxy coatings during development of the specifications. The Waste Feed Receipt Process (FRP) System waste transfer lines are furnished with additional external corrosion protection by adding an external waterproof barrier to the lines in lieu of cathodic protection. This barrier consists of a 2 in. layer of sprayed or injected closed-cell polyurethane foam with an external jacket of extruded high density polyethylene (HDPE) pipe with a minimum thickness of 150 mils. The Technical Notes in the Material Requisition (MRA) require the foam to be fully bonded to the epoxy coating on the outside of the encasement pipe and fully bonded to the inside of the HDPE jacket.<br>Independent Corrosion Expert (ICE) Report: The corrosion protection provisions for the transfer lines considered in this Integrity Assessment have been reviewed by an ICE, Mr. Dennis Helgeson, P.E. His reports are included as attachment A and B to this assessment. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Corrosion Allowance** | Corrosion allowance is adequate for the intended service life of the ancillary equipment. | 24590-WTP-DB-ENG-01-001, Rev. 1A, Basis of Design;<br>24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria";<br>24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection;<br>24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description | The required service life of 40 years for mechanical systems, e.g. piping, is identified in the Basis of Design. The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for WTP piping. Consideration of corrosion, including corrosion allowance, is a mandatory requirement of ASME B31.3. The Underground Pipe Protection document identifies the choice of 304L and 316L stainless steel as conservative for the primary underground transfer lines which are free-draining, operated only periodically during transfers, and are flushed with inhibited water after each transfer. The corrosion/erosion allowances for underground transfer pipe classes S32B, W31A, W32A and W62F are listed in the Piping Material Class Description document. |
| **Pressure Controls** | Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessels are exceeded. | 24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria" | The Pipe Stress Design Criteria identifies ASME B31.3 as the design code for the ancillary equipment piping. ASME B31.3 requires provision be made to safely contain or relieve any pressure to which the piping may be subjected. ASME B31.3 piping not protected by a pressure relieving device, or that can be isolated from a pressure relieving device must be designed for at least the highest pressure that the system can develop. This requirement applies to the primary transfer lines. The transfer lines all terminate in dip tubes which are free-draining to the heels in the Pretreatment Building tanks. The maximum internal pressure is therefore limited by the design configuration. |
| | Maximum flows and any unusual operating stresses are identified | 24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q);<br>24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q);<br>24590-WTP-PER-PL-02-001, Rev. 3, Piping Material Class Description | The expected flow paths for the ancillary equipment are identified on the reference P&ID drawings. As noted in the adjacent item above, ASME B31.3 requires piping to be designed for the highest pressure that a system can develop. The bounding maximum design temperature and pressure are listed for each piping material class in the Piping Material Class Description. ASME B31.3 and the associated standards are appropriate and adequate for the design of the transfer lines. |

| | Information Assessed | Source of Information | Discussion |
|---|---|---|---|
| **Secondary Containment** | Ancillary equipment is designed with secondary containment that is constructed of materials compatible with the waste and of sufficient strength to prevent failure (pressure gradients, waste, climatic conditions, daily operations), provided with a leak-detection system, and designed to drain and remove liquids. | 24590-PTF-PER-M-02-003, Rev. 1, Underground Pipe Protection;<br>24590-WTP-DC-PS-01-001, Rev 2, Pipe Stress Design Criteria including "Pipe Stress Criteria" and "Span Method Criteria";<br>24590-WTP-PER-J-02-002, Rev. 1, Low Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines;<br>24590-PTF-M6-PWD-P0057, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q);<br>24590-PTF-M6-PWD-P0058, Rev. 0, P&ID Plant Wash and Disposal System Underground Transfer Lines (Q);<br>24590-BOF-3PS-C000-T0002, Rev. 0, Engineering Specification for Excavation and Backfill of Underground Radioactive Waste Transfer Lines;<br>24590-BOF-3PS-CE01-T0001, Rev. 4, Engineering Specification for Excavation and Backfill | The 6 in. diameter carbon steel secondary encasement pipes shown on the P&IDs must be designed to ASME B31.3 as noted in the Pipe Stress Design Criteria. ASME B31.3 requires piping to be designed for superimposed dead loads such as the soil overburden for the buried transfer lines and potential vehicular loads. The Underground Pipe Protection document identifies that the secondary containments have sufficient corrosion endurance to assure that the secondary lines will not leak for a time period sufficient to detect a leaking primary and isolate the transfer line from service. The Excavation and Backfill specifications have specific provisions for the use of controlled density fills for backfilling trench excavations for outside buried piping. They also address granular pipe bedding material that conforms to ASTM D 422 and a proviso that controlled density fill conforming to the ASTM is also acceptable. Installation instructions are provided for installing bedding material to line and grade with dimensional tolerances for minimum and maximum bedding material installation and appropriate lift and compaction requirements. The installation of bedding materials is coordinated with the backfill and compaction requirements for subgrade preparation for roads and paved areas. Testing Procedures and Record Keeping procedures are defined for quality control testing of bedding installation as each lift is placed. The fill and compaction requirements for the installation of underground transfer lines are appropriate and adequate to assure that the lines will perform as designed.<br>The P&IDs show that each transfer line has a low point drain and leak detection to identify primary line leaks. Details of the leak detection system are discussed in the Low Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines document. Flushing capabilities are provided at the high point end of of each transfer line for removing leaked waste or accumulated liquid in the secondary lines by flushing to the low point drains. |

# ATTACHMENT A

# CORROSION INTEGRITY ASSESSMENT OF WASTE TRANSFER PIPELINES IN THE HANFORD WASTE TREATMENT PLANT

Corrosion Control Specialist,
Dennis P. Helgeson, P.E.

(5 pages including coversheet)

C C S **Corrosion Control Specialists**

P.O. Box 5303
Kent, Washington 98064-5303
Phone (253) 520-3424 • Fax (253) 520-3425

CORROSION INTEGRITY ASSESSMENT OF

Waste Transfer Pipelines in the
Hanford Waste Treatment Plant
Owned/Operated by the U. S. Department of Energy
Office of River Protection, Richland Washington
per WAC 173-303-640(3)(a) through (g)

This corrosion certification is for the waste transfer pipelines at the Hanford Waste Treatment Plant Richland, Washington. The transfer pipelines included in this certification are shown on drawings 24590-PTF-M6-PWD-P0057 AND –P0058 with the exception of the two lines on hold (RLD-ZS-03382-F10A AND RLD-03383-F10A-03). This corrosion integrity assessment was conducted to identify components of the environment or the piping network that could lead to corrosion damage to the pipe that could lead to failure of the pipe. The assessment evaluated the corrosion protection measures taken to assure that they were correctly designed and compatible with the environment in which they are to operate. This assessment is provided as a subcontract from COGEMA Engineering. This assessment has considered:

A. CORROSION/CORROSION CONTROL STANDARDS, DESIGN STANDARDS AND ENGINEERING DOCUMENTS:

| | |
|---|---|
| NFPA 70 - 1996 | National Electrical Code (NEC) |
| NACE International RP-0169-1996 | Recommended Practice. "Control of External Corrosion on Underground or Submerged Metallic Piping Systems" |
| WAC 173-303-640 - October 3, 2001" | Washington Administrative Code, Title 173, WAC Department of Ecology, Dangerous Waste Regulations for Tank Systems |
| NACE-RP-0274 | High Voltage Electrical Inspection of Pipeline Coatings |

Steel Structures Painting Council (SSPC)

| | |
|---|---|
| SSPC-SPI | Solvent Cleaning |
| SSPC-SPIO | Near-White Blast Cleaning |
| SSPC-SP11 | Power Tool Cleaning to Bare Metal |
| SSPC-VISI | Visual Standards for Abrasive Blast Cleaned Steel |
| SSPC-PA2 | Measurement of Dry Paint Thickness with Magnetic Gauges |

| | |
|---|---|
| Bechtel Document | 24590-WTP-DB-ENG-01-001, REV 0 – Basis for Design |
| NACE Publication | Corrosion Data Survey compiled by Norman E. Hamner – Metals Section |

B PLANT DESIGN DOCUMENTS REVIEWED IN PREPARATION OF THE ASSESSMENT

| | |
|---|---|
| 24590-BOF-3PS-CE01-T0001, Rev. 4 | Engineering Spec for Excavation and Backfill |
| 24590-WTP-PER-J-02-002, Rev. 1 | Low-Point Leak Detection in Secondary Containment Systems for Buried Co-Axial Transfer Lines |
| 24590-PTF-PER-M-02-003, Rev. 1 | Underground Pipe Protection |
| 24590-WTP-PER-PS-02-001, Rev. 3 | Ancillary Equipment Pipe Support Design |
| 24590-WTP-PER-PL-02-001, Rev 2 | Piping Material Class Description |
| 24590-WTP-3PS-NWP0-T0001, Rev.1 | Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping |
| 24590-WTP-3PS-PB01-T0001, Rev. 0 | Engineering Specification for Technical Supply Conditions for Pipe, Fittings, and Flanges |
| SCN NO. 24590-WTP-3PN-PB01-00001 | Change Notice for the specification listed above |
| 24590-WTP-3PS-PS02-T0001, Rev. 2 | Engineering Specification for Shop Fabrication of Piping |
| SCN NO. 24590-WTP-3PN-PS-02-00008 | Change Notice for the specification listed above |
| 24590-WTP-3PS-PS02-T0002, Rev. 1 | Engineering Specification for Cold Bending of Pipe |
| SCN NO. 24590-WTP-3PN-PS02-00010 | Change Notice for the specification listed above |
| 24590-WTP-3PS-PX04-TP001, Rev. 0 | Specification for Shop Applied Fusion Bonded Epoxy Coating for Underground Carbon Steel Pipe |
| 24590-WTP-3PS-PX04-T0004, Rev. 0 | Engineering Specification for Epoxy Coating of Stainless Steel Items that Are Buried, Embedded or Insulated |
| 24590-WTP-3PS-G000-T0001, Rev. 0 | General Specification for Supplier Quality Assurance Program Requirements |
| 24590-WTP-3PS-EQ00-T0002, Rev. 2 | Engineering Specification for Cathodic Protection |
| 24590-WTP-3YD-CPE-00001, Rev. C | System Description for Cathodic Protection |
| WTSC99-1036-42-17 | RPP-WTP Geo-technical Investigation Final Report, Shannon & Wilson, 2000 |
| 24590-PTF-M6-PWD-P0057, Rev. 0 | P&ID Plant Wash & Disposal System Underground Transfer Lines (Q) |
| 24590-PTF-M6-PWD-P0058, Rev. 0 | P&ID Plant Wash & Disposal System Underground Transfer Lines (Q) |
| 24590-PTF-3YD-PWD-00001, Rev. 0 | System Description for Plant Wash and Disposal System PWD and Radioactive Liquid Waste Disposal System RLD |
| 24590-WTP-3PS-DB01-T0001, Rev. 6 | Engineering specification for Furnishing and delivering Ready Mix Concrete |
| 24590-BOF-3PS-C000-T0002, Rev. 0 | Engineering Specification for Excavation and Backfill of Underground Radioactive Waste Transfer Lines |
| 24590-PTF-M6-PWD-P0002, Rev. 1 | P&ID Plant Wash & Disposal System Effluent Collection System PWD-VSL-00033/00043/00044 |
| 24590-BOF-C2-C12T-00002, Rev. 3 | RPP-WTP General Arrangement Plan |
| 24590-PTF-P1-P01T-P0011, Rev. 3 | Pretreatment Facility General Arrangement Section E-E |
| 24590-PTF-P1-P01T-P0008, Rev. 2 | Pretreatment Facility General Arrangement Section B-B |

C. CHARACTERISTICS OF THE SOILS SURROUNDING THE PIPELINES AND THE RATES OF CORROSION THAT MIGHT BE EXPECTED

See "Buried Pipeline and Ancillary Equipment vs. Soil Environment Compatibility Report for Buried Pipelines at River Protection Project – Waste Treatment Plant dated August 11, 2003 attached.

D. PLANNED CORROSION PROTECTION MEASURES:

1 Impressed current cathodic protection

2 Fusion bonded epoxy coating

3. Corrosion allowance included in pipe material specification.

OR

1 Isolation of the steel pipe from contact with the soil

2 Corrosion allowance included in pipe material specification.

E: COMMENTS:

COGEMA Engineering has provided all documents requested in completing this assessment. COGEMA personnel interviewed were fully responsive to all inquires about the subject pipelines, their operation, or the soil environment into which they are to be placed. Notwithstanding the statements or information contained herein, this assessment conducted by Corrosion Control Specialists is based on that data and information supplied by COGEMA.

F CERTIFICATION LIMITATIONS;

This certification is only for the identified pipe material, coating, and cathodic protection specified in the design documents reviewed. If the materials of construction change or if the planned operation or use is changed or if a significant structural change is made, a new assessment certification is required.

## CORROSION INTEGRITY ASSESSMENT CERTIFICATION

I, Dennis Helgeson have reviewed, and certified a portion of a design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by the U. S. Department of Energy, Office of River Protection, Richland Washington. My duties, as an independent corrosion expert, were to review the design for the waste transfer piping inside the plant to determine if it was compatible with the soils at the site and would not fail as a result of corrosion damage, as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) (a).

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 undersigned is a registered professional engineer in the state of Washington.

Signature: Dennis R Helgen Date: 8/11/03

Company: Corrosion Control Specialists
P. O. Box 5303
Kent, WA 98064

Telephone: (253) 520-3424 Fax: (253) 520-3425

DENNIS R. HELGEN
STATE OF WASHINGTON
8231
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 12/24/04

# ATTACHMENT B

## BURIED PIPELINE AND ANCILLARY EQUIPMENT vs. SOIL ENVI RONMENT COMPATIBILITY REPORT

Corrosion Control Specialist,
Dennis P. Helgeson, P.E.

(7 pages including coversheet)

C C S Corrosion Control Specialists
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# BURIED PIPELINE AND ANCILLARY EQUIPMENT VS SOIL ENVIRONMENT COMPATIBILITY REPORT

for the
River Protection Project - Waste Treatment Plant
Hanford, Washington

The U.S. Department of Energy (DOE) plans to construct a dangerous waste Waste Treatment Plant (WTP) at their Hanford, Washington facility. Construction of the plant is part of the DOE River Protection Project. Mixed waste will be received, pretreated, and vitrified in three primary waste treatment facilities. Waste will be transferred into the WTP, between WTP waste treatment facilities, and out of the WTP in buried piping. That transfer piping is the subject of this compatibility report. This report addresses only pipelines that will have active cathodic protection.

This report is being prepared to assure compliance with the state of Washington Department of Ecology regulation described in WAC 173-303-640(3) and its guidance 94-114.

## Pipeline Design

The buried transfer piping for the WTP will be a sloped coaxial system. The coaxial system for transfer of the waste is made up of a carrier pipe made of 316L stainless steel to contain the waste. That carrier pipe will run inside an encasement pipe that is made of carbon steel. The encasement pipe is a secondary containment system in the event of a leak from the carrier pipe. The encasement pipe also isolates the carrier pipe from corrosion by the surrounding soils. The encasement pipes are to be 6-inch diameter Schedule 40 carbon steel. The pipe will have a nominal wall thickness of 0.280 inches. A leak detection system is incorporated into the pipeline design to provide an alarm in the event of a leak. The exterior of the encasement pipe is to be coated with a factory applied fusion bonded epoxy (FBE). The FBE is a primary method of corrosion control by isolating the pipe from contact with the soil. Specifications for the coating and its application are described in Bechtel documents 24590-WTP-3PS-PX04-T0001, Rev 0 and 24590-WTP-3PS-PX04-T0004, Rev 0. The specification for the WTP recognizes that the FBE may not be 100 percent effective and calls for the installation of cathodic protection to

supplement it. Details of the Bechtel's plan for cathodic protection are described in their documents 24590-WTP-3PS-EQ00-T0002, Rev 2 and 24590-WTP-3YD-CPE-00001, Rev C.

The drawings 24590-PTF-M6-PWD-P0057 and –P0058 identify the transfer pipelines that are the subject of this report. All of the pipelines shown on these drawings are within the scope of this report with the exception of the two lines on hold (RLD-ZS-03383-F10-03 and RLD-ZS-03382-F10A-04) which are the effluent lines from the Waste Treatment Plant to the Hanford site disposal facilities, the LERF and ETF facilities. Also the three transfer lines from the Hanford Tank Farms to the Pretreatment Facility (FRP-PZ-01749-W62F-03, FRP-PZ-01750-W62F-03, and FRP-PZ-01751-W62F-03) are excluded from the cathodic protection engineering specification, and are therefore not the subjects of cathodic protection discussed in this report. This report considers the metallic pipe that makes up the transfer piping at the WTP. It does not address any FRP piping nor does it address any steel piping that is isolated from the soil environment by encasement in high-density polyethylene pipe.

The compatibility of the carrier pipe with the wastes being transferred inside it is not the subject of this report. That compatibility is the responsibility of others. Any corrosion that might occur in the annular air space between the carrier pipe and the encasement pipe should be minimal to nil but that compatibility evaluation is also the responsibility of others.

This report is to evaluate if the FBE coating and cathodic protection system make the encasement pipe compatible with the soils at the site.

A detailed description of the make up of the piping network at the WTP is described in the following Bechtel documents:

24590-BOF-3PS-CE0I-T0001, Rev. 4
24590-WTP-PER-J-02-002, Rev. 1
24590-PTF-PER-M-02-003, Rev. 1
24590-WTP-PER-PL-02-001, Rev. 2
24590-WTP-3PS-NWP0-T0001, Rev. 1
24590-WTP-3PS-PB01-T0001, Rev. 0
24590-WTP-3PS-PS02-T0001, Rev. 2
24590-WTP-3PS-PS02-T0002, Rev. 1
24590-WTP-3PS-G000-TP002, Rev. 1

Soil Environment

To evaluate the relative corrosion performance of different soils a number of properties of the soil are evaluated. The principal properties evaluated are outlined in WAC 173-303–640(3)(a)(iii)(A)(I-VIII) to include:

(I) Soil moisture content
(II) Soil pH
(III) Soil sulfides level

(IV) Soil resistivity
(V) Structure to Soil Potentials
(VI) Influence of nearby underground metallic structures
(VII) Existence of stray electric currents
(VIII) Existing corrosion protection methods

The moisture content of soils at the WTP site varies seasonally between 2-4 %. The pH of the soils recently measured at the site ranged from 5.84 to 7.94 with an average of 6.88. Sulfates and chlorides measured at the site were below detectable limits or below any threshold that would impact corrosion of carbon steel. In-situ soil resistivity ranged from 14,300 to 143,000 ohm-cm with an average of 61,300 ohm-cm. Laboratory testing indicated resistivity between 61,000 and over a million ohm-cm. In as much as this is a planned facility no structure to soil potentials have been recorded. The site for the WTP is near the 200 East area and evaluation of the nearby buried tanks are a consideration as well as any stray current that might result from cathodic protection of those tanks. Interaction between cathodic protection systems in the 200 East Area and cathodic protection systems at the WTP site would be a design consideration for waste transfer lines routed between the sites. A summary of all the soil properties is tabulated and discussed in the Shannon & Wilson Report WTSC99-1036-42-17.

Other Corrosion Considerations

The corrosion of steel in soils is an electrochemical process and not just chemical interaction of the soil with the metal. The electrochemical theory is that four elements are necessary for corrosion to occur. The four elements are anodes on the metal surface, cathodes on the metal surface, a metallic path between the anode and cathode (the metal itself) and an electrolyte (soil). This model of corrosion is referred to as a corrosion cell. If all four elements are present, direct current flows from the anode areas into the soils, through the soil and onto the cathode areas, and through the metal back to the anode. Anodes and cathodes occur on the metal surface caused by a wide variety of reasons including:

Alloying of the metals
Differential aeration of the soil
Different resistivity of the electrolyte
Cold working of metal surface
Coupling of two different metal in the electrolyte
Welded areas vs. un-welded areas of metal surface
Coated or un-coated areas of metal surface
Stray Current

Many of these conditions are present for the intra plant-piping network planned for this WTP site. The encasement pipe as specified is alloyed carbon steel creating the initial anode – cathodes cells. The FBE coating specified is an excellent coating and tight quality control is planned for factory application. However the coating will still have some holidays that go undetected and the coating will experience some undetected nicks and scrapes during installation. Additionally the piping will

be inter-tied with valves, pumps, leak detection probes, etc which will be made up of different metals creating galvanic couples. Moreover field coating of the weld joints cannot fully match the quality achieved at the factory. Further the piping in the plant may pass under roads or paved areas in one area while in other areas in may be under native soil. Areas under the paved areas will have reduced moisture content and a lower aeration content than the native soil areas. The encasement clearly will experience corrosion by interaction with the soil environment.

## Discussion

The Table shown below was published as part of the National Association of Corrosion Engineers (NACE) Basic Corrosion Course. It is intended to be a guideline of possible corrosion in homogenous soil. Considering the soil conditions at the WTP described above, the soils would be classified as only progressively less corrosive to carbon steel.

Rough Indications of Soil
Corrosivity vs. Resistivity

| Ohm-cm | Description |
|---|---|
| Below 500 | Very corrosive |
| 500-1,000 | Corrosive |
| 1,000-2,000 | Moderately corrosive |
| 2,000-10,000 | Mildly corrosive |
| Above 10,000 | Progressively less corrosive |

If one uses it as a guide for the WTP, it suggests the WTP_would expect very little corrosion of buried metals at the site. However, since the resistivity at the site is not homogenous but rather is heterogeneous, the different corrosion cells created by different resistivities at the site will increase corrosion above that indicated by the above table.

A NACE publication "Corrosion Data Survey" has compiled empirical historical data on corrosion rates of carbon steel in various soil resistivities. From this information we find a range of corrosion rates for the resistivity at the WTP. Corrosion rates could be less than 2 mils per year to as high as 10 mils per year. If this relative guide were used we would expect serious damage from anywhere from 15 to 70 years. Since most of the resistivity data is well above the 10,000 ohm-cm level it more likely closer to the 70 years than 15. However this determination of corrosion rates is subjective based on the experience of the corrosion engineer. Neither use of this approach nor the table above provides a satisfactory way for determining compatibility of the piping network at the WTP site.

If it were known the metals were buried in a homogenous soil then laboratory testing could be conducted to determine a more objective prediction of corrosion rates. The laboratory approach would be to complete a linear polarization curve to determine the polarization resistance. Then, the data would be combined with the electrochemical constant and the surface area of the test sample in an equation that results in corrosion rates in mils per year. However nonuniform soils

are present at the site, thus precluding use of this approach. Moreover the pipelines on the site will be subjected to some increased corrosion as indicated by the other corrosion consideration noted above. The corrosion impact of these factors would be left out of any corrosion rate calculation.

The determination in this case as in most soils leaves the expected corrosion rates determination to a subjective determination of a corrosion engineer based on his experience. Even if a corrosion rate for the WTP site could be defined, the other information needed to determine the pipe-soil compatibility is the planned life of the pipelines. The amount of waste to be processed at the WTP and the time needed to process the waste are just estimates. Therefore with only a rough indication corrosion rate in these soils and a planned design life of 40 years for the_WTP corrosion mitigating measures are required to assure pipe-soil compatibility.

The methods available to mitigate corrosion cells include the following:

1. Remove or insulate the electrical path between anodes and cathodes
2. Change or treat the soil
3. Isolate the pipe from the soil.
4. Apply anodic or cathodic protection

The first two approaches are not practical for any buried piping network. The most common method of accomplishing the third approach is to apply a non-conductive coating to the pipeline surface. A good coating system effectively isolates nearly all the pipe from the soil. However pinholes and holidays may exist in most coatings and some metal will remain in contact with the soil. Some corrosion can be expected to continue. Anodic protection is impractical for a buried pipeline system A correctly designed and operated cathodic protection system will effectively mitigate all corrosion on the pipeline by sacrificing another material (anode) that is remote from the metal surface. With an effective cathodic protection system installed at the WTP, there wouldn't be any corrosion of the pipeline and it would be considered compatible with the soil.

Applying cathodic protection to a bare steel pipeline results in high installation cost and high operating expenses. Good engineering practice is to apply a coating to the pipeline and also install cathodic protection. The cost of installing and operating a cathodic protection system for a coated pipeline is 5% or less of that required for a bare pipe. The cathodic protection system for a coated pipeline is protecting just the pinholes or holidays in the coating that comes in contact with the soil. The WTP plan calls for this approach of applying cathodic protection to a coated piping network. This plan for the WTP piping is good engineering practice. The question remains is the coating system specified and the cathodic protection specified adequate to make the pipelines at the WTP compatible with the site soils?

The selection of FBE coating for the WTP is an excellent choice for this application because it is environmentally compatible with the soils and will provide an excellent barrier between the pipe and soil with the minimum of holidays. The FBE coating called out in the project specifications is of the highest quality. The specifications outlines excellent application procedures. The specification requires detailed inspection procedures for quality control for application of the

coating. Moreover the storage, handling and shipping procedures for the pipe in route to the WTP site should ensure the pipe is placed in the ground in excellent condition.

The cathodic protection system specification for the WTP requires the quality of all system components to be met with the national standards by the designer. It provides the designer with direction on what installation practices may be used at the site. It requires the designer establish quality assurance procedures for the design, procurement, and installation of the system. A cathodic protection system designed and installed in accordance with the specification will provide a system that will mitigate all corrosion of the pipelines at the WTP.

In my professional opinion that if the piping is coated with FBE in accordance with the specification and is cathodically protected in accordance with the specification the pipelines will be compatible with the soils at this WTP.

Dennis R. Helgeson, P. E.
Corrosion Specialists # 2736

8/11/03
Date