ISSUED BY
RPP-WTP PDC

Document title: **Materials for Ancillary Equipment**

Contract number: DE-AC27-01RV14136

Department: Engineering

Author(s): DE Mitchell

Principal author signature:

Document number: 24590-WTP-PER-M-02-002, Rev 2

Checked by: JR Divine

Checker signature:

Date of issue: 10/21/08

Issue status: Approved

Approved by: SW Vail

Approver's position: Supervisor, Materials Engineering Technology

Approver signature:

This bound document contains a total of 8 sheets

River Protection Project
Waste Treatment Plant
2435 Stevens Center Place
Richland, WA 99354
United States of America
Tel: 509 371 2000

Notice

Please note that source, special nuclear, and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the US 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.

History Sheet

Rev	Date	Reason for revision	Revised by
0	8/22/02	Issued for Permitting Use	JR Divine
1	3/19/04	Issued for Permitting Use	JR Divine
2	10/21/08	Total Revision, Issued for Permitting Use	DE Mitchell

Contents

1 Introduction

The Washington Administrative Code, 173-303-640(3)(a), states that the tank system and ancillary equipment shall be compatible with the waste. This report addresses material selection for corrosion protection of WTP ancillary waste containment equipment. External corrosion protection of pipe in direct contact with the soil or water is not addressed in this report.

According to WAC-173-303-040, Definitions: "Ancillary equipment" means any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps, that is used to distribute, meter, or control the flow of dangerous waste from its point of generation to a storage or treatment tank(s), between dangerous waste storage and treatment tanks to a point of disposal on-site, or to a point of shipment for disposal off-site. The definition as used here does not include gaskets, seals, or other non-metallic components.

2 Applicable Documents

The Washington Administrative Code, WAC-173-303-640, Tank Systems

3 Description

The waste containment piping and ancillary equipment material selection is based on the Corrosion Evaluations performed for vessels, tanks, columns, evaporators, ultrafilters, filtration units, lutepots, and breakpots (herein after all are referred to as vessels). Corrosion Evaluations include reviews of:

- General Corrosion,
- Pitting Corrosion,
- End Grain Corrosion,
- Stress Corrosion Cracking,
- Crevice Corrosion,
- Corrosion at Welds,
- Microbiologically Induced Corrosion (MIC),
- Fatigue/Corrosion Fatigue,
- Vapor Phase Corrosion,
- Erosion,
- Galling,
- Fretting/Wear,
- Galvanic Corrosion,
- Cavitation, and
- Creep

3.1 Heat Exchangers

Corrosion Evaluations for process heat exchangers address both the process and cooling sides of the heat exchanger

In tube heat exchangers the shell has a suitable corrosion allowance based on the shell material, the design life of the heat exchanger, and fluid contained by the shell. The corrosion allowance of the tubes might be zero where provisions have been made to replace the heat exchanger and/or tubes, and adding material to the tubes will greatly increase the heat transfer resistance and the size of the heat exchanger.

3.2 Pumps

Corrosion Evaluations are prepared, as required, for the containment boundaries of the pump. For pumps, where more wear can be expected due to increased velocities, a Corrosion Evaluation is prepared for the component to ensure that the materials specified are consistent with the expected chemistry, pH, temperature, and process conditions. Based on the design life of centrifugal pumps, the less easily replaced volute casing has a larger corrosion allowance than the impeller, which may have to be replaced as the efficiency of the pump decreases.

3.3 Piping

Because of the detailed corrosion analysis done on each vessel and the large number of pipes entering or leaving each vessel, a conservative approach has been used. This approach is to construct ancillary equipment downstream of a source vessel of the same material as the vessel and with the same or greater corrosion allowance. If the service seen in the downstream line warrants a different material or corrosion allowance, approval from the Materials Engineering Technology (MET) group is required.

Some exceptions to this philosophy include offgas lines or liquid pipelines exposed to multiple liquids or piping exposed to the same waste stream as the vessel but for shorter periods of times and at the same or lower temperatures as the vessel. Under these conditions, a less resistant material or lower corrosion allowance would be acceptable.

Drain piping that drains to vessels is typically 316L stainless steel. This is based on their limited use and flushing after use.

Exceptions are made for extremely long lines, such as for transfer lines between facilities, that will be flushed and, if needed, flushed with alkaline solutions after each use. Exceptions can also be made if the component is maintainable. In those cases, the alloy selected may be slightly less corrosion resistant but fully qualified for its use and expected life. If the restrictions given for an exemption cannot be met or the specified alloy is not available, then a more corrosion resistant alloy, as specified on the Corrosion Evaluation for the vessel, may be used. Steam ejectors located in some vessels and the downstream lines are subjected to an elevated temperature, they may be fabricated from the more corrosion resistant Hastelloy C-22.

Several high performance materials, erosion and corrosion resistant, are used in the WTP piping systems. These include:

UNS No.	Trade Name	Typical WTP Application
S30403	304L	air, water, reagents, nitric acid, waste, some vent systems
S31603	316L	water, dilute nitric acid, waste, vent systems
N08367/N08926	6% Mo	waste
N06022	Alloy C-22	waste
R50400	Ti-2	canister, cerium nitrate, decontamination

When chemical compatibility is not a question, but erosion is a concern, additional erosion allowances will be specified.

Slurries without glass formers:
Generally the corrosion resistant alloys, i.e. stainless steel, 6% Mo, and C-22, are also resistant to erosion when the slurry velocity is less than 12 feet per second and undissolved solids content is less than or equal to 2wt%. In this case the erosion allowance is 0.004 inch for a 40 yr allowance.

When the undissolved solids content is greater than 2wt% but less than or equal to approximately 27.3 wt% the erosion allowance is 0.016 inch.

When the velocity and/or undissolved solids content is greater or other materials of construction specified, the erosion allowance shall be justified by calculation.

Slurries with glass formers:
When slurry velocity is less than 10 feet per second, a 40 yr erosion allowance of 1/8 inch is added. When velocities are greater than 10 feet per second the erosion allowance, or other materials of construction, shall be justified by calculation.

As noted above, selection criteria are documented in the Corrosion Evaluations.

4 Application of the information

The lowest acceptable piping materials are shown on Material Selection Guide drawings which depict the materials for major process lines. A piping class that is consistent with the material shown on the Material Selection Guide, the process fluid code, and the solids content of the fluid are shown by the piping class for each pipeline on the Piping and Instrument Diagram (P&ID). As part of the check procedure to ensure that the correct material has been chosen, the P&ID is routed through the MET group as required to ensure that the piping class chosen meets the required material and corrosion allowances.

5 Summary

1. Ancillary equipment is fabricated from the same material, or better, as the source vessel unless otherwise specified by the MET group.

2. The corrosion allowances used for the ancillary equipment are the same as that of the source vessel unless the MET group determines that the service seen in the downstream line warrants a different material, corrosion allowance, or other modification.

3. Any exceptions to (1 or 2) are evaluated by the MET group and may result in additional operating restrictions.

4. As part of the check procedure to ensure that the correct material has been chosen, the P&ID is routed through the MET group as required to ensure that the piping class chosen meets the required material and corrosion allowances.