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Section 2 of 14

Document Information			
Document #	0602648		
Title	DRAFT WTP DANGEROUS WASTE PERMIT		
Date	10/04/2006		
Originator	HEDGES JA	Originator Co.	DOEC
Recipient	SCHEPENS RJ, KLEIN K, WILKINS WS	Recipient Co.	DOE-ORP, DOE-RL, BNI
References	WA7890008967		
Keywords			
Projects	RPP		
Structure			

Table III.10.I.D - Maximum Feed-rates to LAW Vitrification System (RESERVED)

Description of Waste	Normal Operation
Dangerous and/or Mixed Waste Feed Rate	
Ash Feed Rate	
Total Chlorine/Chloride Feed Rate	
Total Metal Feedrates	

Table III.10.I.E - LAW Vitrification System Estimated Emission Rates (RESERVED)

Chemicals	CAS Number	Emission Rates (grams /second)

TABLE III.10.I.F - LAW Vitrification System Waste Feed Cut-off Parameters*[1](RESERVED)

Sub-system Designation	Instrument Tag Number	Parameter Description	Set-points During Normal Operation

*A continuous monitoring system ~~shall~~ will be used as defined in Permit Section III.10.C.1.

[1]Maximum Feed-rate ~~shall~~ will be set based on not exceeding any of the constituent (e.g., metals, ash, and chlorine/chloride) feed limits specified on Table III.10.I.D. of this Permit

corrosion expert to ensure proper installation [WAC 173-303-640(3)(g), in accordance with WAC 173-303-680(2) and (3)].

III.10.J.1.a.ix. Prior to initial receipt of dangerous and/or mixed waste in the WTP Unit, the Permittees ~~shall~~ will obtain and keep on file in the WTP Unit operating record, written statements by those persons required to certify the design of the HLW Vitrification System and supervise the installation of the HLW Vitrification System, as specified in WAC 173-303-640(3)(b), (c), (d), (e), (f), and (g), in accordance with WAC 173-303-680, attesting that the HLW Vitrification system and corresponding containment system listed in Permit Tables III.10.J.A and III.10.J.B, as approved/modified pursuant to Permit Condition III.10.J.5., were properly designed and installed, and that repairs, in accordance with WAC 173-303-640(3)(c) and (e), were performed [WAC 173-303-640(3)(a) and WAC 173-303-640(3)(h), in accordance with WAC 173-303-680(3)].

III.10.J.1.a.x. The independent HLW Vitrification System installation inspection and subsequent written statements ~~shall~~ will be certified in accordance with WAC 173-303-810(13)(a), as modified pursuant to Permit Condition III.10.J.1.a.iii., comply with all requirements of WAC 173-303-640(3)(h) in accordance with WAC 173-303-680, and ~~shall~~ will consider, but not be limited to, the following LAW Vitrification System installation documentation:

A. Field installation report with date of installation;

B. Approved welding procedures;

C. Welder qualification and certifications;

D. Hydro-test reports, as applicable, in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1; American Petroleum Institute (API) Standard 620, or Standard 650, as applicable;

E. Tester credentials;

F. Field inspector credentials;

G. Field inspector reports;

H. Field waiver reports; and

I. Non-compliance reports and corrective action (including field waiver reports) and repair reports.

III.10.J.1.a.xi. The Permittees ~~shall~~ will ensure periodic integrity assessments are conducted on the HLW Vitrification System, listed in Permit Table III.10.J.A, as approved/modified pursuant to Permit Condition III.10.J.5., over the term of this Permit, in accordance with WAC 173-303-680(2) and (3) as specified in WAC 173-303-640(3)(b), following the description of the integrity assessment program and schedule in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c. Results of the integrity assessments ~~shall~~ will be included in the WTP Unit operating record until ten (10) years after post-closure, or corrective action is complete and certified, whichever is later.

III.10.J.1.a.xii. The Permittees ~~shall~~ will address problems detected during the HLW Vitrification System integrity assessments specified in Permit Condition III.10.J.1.a.xi. following the integrity assessment program in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c.

III.10.J.1.a.xiii. All process monitors/instruments as specified in Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., ~~shall~~ will be equipped with operational alarms to warn of deviation, or imminent deviation from the limits specified in Permit Table III.10.J.F.

III.10.J.1.a.xiv. The Permittees ~~shall~~ will install and test all process and leak detection system monitors/instrumentation as specified in Permit Tables III.10.J.C and III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5, in accordance with Operating Unit 10, Appendices 10.1, 10.2, and 10.14 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.d.x. and III.10.J.5.f.xvi.

III.10.J.1.a.xv. No dangerous and/or mixed waste ~~shall~~ will be treated in the HLW Vitrification System unless the operating conditions, specified under Permit Condition III.10.J.1.c. are complied with.

III.10.J.1.a.xvi. The Permittees ~~shall~~ will not place dangerous and/or mixed waste, treatment reagents, or other materials in the HLW Vitrification System if these substances could cause the subsystem, subsystem equipment, or the containment system to rupture, leak, corrode, or otherwise fail [WAC 173-303-640(5)(a), in accordance with WAC 173-303-680(2)]. This condition is not applicable to corrosion of HLW Vitrification System sub-system and sub-system equipment that are expected to be replaced as part of normal operations (e.g., melters).

III.10.J.1.a.xvii. The Permittees ~~shall~~ will operate the HLW Vitrification System to prevent spills and overflows using description of controls and practices as required under WAC 173-303-640(5)(b) described in Permit Condition III.10.C.5, and Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e. [WAC 173-303-640(5)(b), in accordance with WAC 173-303-680(2) and (3), and WAC 173-303-806(4)(c)(ix)].

III.10.J.1.a.xviii. For routinely non-accessible HLW Vitrification System sub-systems, as specified in Operating Unit 10, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., the Permittees ~~shall~~ will mark all routinely non-accessible HLW Vitrification System sub-systems access points with labels or signs to identify the waste contained in each HLW Vitrification System sub-system. The label, or sign, must be legible at a distance of at least fifty (50) feet, and must bear a legend which identifies the waste in a manner which adequately warns employees, emergency response personnel, and the public of the major risk(s) associated with the waste being stored or treated in the HLW Vitrification System sub-systems. For the purposes of this permit condition, "routinely non-accessible" means personnel are unable to enter these areas while waste is being managed in them [WAC 173-303-640(5)(d), in accordance with WAC 173-303-680(2)].

III.10.J.1.a.xix. For all HLW Vitrification System sub-systems not addressed in Permit Condition III.10.J.1.a.xviii., the Permittees ~~shall~~ will mark all these HLW Vitrification System sub-systems holding dangerous and/or mixed waste with labels or signs to identify the waste contained in the HLW Vitrification System sub-systems. The labels, or signs, must be legible at a distance of at least fifty (50) feet, and must bear a legend which identifies the waste in a manner which adequately warns employees, emergency response personnel, and the public of the major risk(s) associated with the waste being stored or treated in the HLW Vitrification System sub-systems [WAC 173-303-640(5)(d), in accordance with WAC 173-303-680(2)].

III.10.J.1.a.xx. The Permittees ~~shall~~ will ensure that the containment systems for the HLW Vitrification System sub-systems listed in Permit Tables III.10.J.A. and III.10.J.B, as approved/modified pursuant to Permit Condition III.10.J.5, are free of cracks or gaps to prevent any migration of dangerous and/or mixed waste or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during use of the HLW Vitrification System sub-systems. Any indication that a crack or gap may exist in the containment systems ~~shall~~ will be investigated and repaired in accordance with Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e.v. [WAC 173-303-640(4)(b)(i), WAC 173-303-640(4)(e)(i)(C), and WAC 173-303-640(6), in accordance with WAC 173-303-680(2) and (3), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-320].

III.10.J.1.a.xxi. The Permittees must immediately, and safely, remove from service any HLW Vitrification System or secondary containment system which, through an integrity assessment, is found to be "unfit for use" as defined in WAC 173-303-040, following Permit Conditions III.10.J.1.a.xxiii.A. through D., and F. The affected HLW Vitrification System, or secondary containment system, must be either repaired or closed in accordance with Permit Condition III.10.J.1.a.xxiii.E. [WAC 173-303-640(7)(e) and (f), and WAC 173-303-640(8), in accordance with WAC 173-303-680(3)].

III.10.J.1.a.xxii. An impermeable coating, as specified in Operating Unit 10, Appendices 10.4, 10.5, 10.7, 10.9, 10.11, and 10.12 of this Permit, as approved pursuant to Permit Condition III.10.J.5.b.v., ~~shall~~ will be maintained for all concrete containment systems and concrete portions of containment systems for each HLW Vitrification System sub-systems listed in Permit Tables III.10.J.A and III.10.J.B as approved/modified pursuant to Permit Condition III.10.J.5 (concrete containment systems that do not have a liner, pursuant to WAC 173-303-640(4)(e)(i), in accordance with WAC 173-303-680(2), and have construction joints, ~~shall~~ will meet the requirements of WAC 173-303-640(4)(e)(ii)(C), in accordance with WAC 173-303-680(2). The coating ~~shall~~ will prevent migration of any dangerous and mixed waste into the concrete. All coatings ~~shall~~ will meet the following performance standards:

A. The coating must seal the containment surface such that no cracks, seams, or other avenues through which liquid could migrate, are present;

B. The coating must be of adequate thickness and strength to withstand the normal operation of equipment and personnel within the given area such that degradation or physical damage to the coating or lining can be identified and remedied before dangerous and mixed waste could migrate from the system; and

C. The coating must be compatible with the dangerous and mixed waste, treatment reagents, or other materials managed in the containment system [WAC 173-303-640(4)(e)(ii)(D), in accordance with WAC 173-303-680(2) and (3), and WAC 173-303-806(4)(i)(i)(A)].

III.10.J.1.a.xxiii.The Permittees ~~shall~~ will inspect all containment systems for the HLW Vitrification System sub-systems listed in Permit Tables III.10.J.A and III.10.J.B, as approved/modified pursuant to Permit Condition III.10.J.5., in accordance with the Inspection Schedule specified in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c., and take the following actions if a leak or spill of dangerous and/or mixed waste is detected in these containment systems [WAC 173-303-640(5)(c) and WAC 173-303-640(6), in accordance with WAC 173-303-680(2) and (3), WAC 173-303-320, and WAC 173-303-806(4)(i)(i)(B)]:

A. Immediately, and safely, stop the flow of dangerous and/or mixed waste into the HLW Vitrification System sub-systems or secondary containment system.

B. Determine the source of the dangerous and/or mixed waste.

C. Remove the dangerous and/or mixed waste from the containment area in accordance with WAC 173-303-680(2) and (3), as specified in WAC 173-303-640(7)(b). The dangerous and/or mixed waste removed from containment areas of the HLW Vitrification System sub-systems ~~shall~~ will be, as a minimum, managed as mixed waste.

D. If the cause of the release was a spill has not damaged the integrity of the HLW Vitrification System sub-system, the Permittees may return the HLW Vitrification System sub-system to service in accordance with WAC 173-303-680(2) and (3), as specified in WAC 173-303-640(7)(e)(ii). In such case, the Permittees ~~shall~~ will take action to ensure the incident that caused the dangerous and/or mixed waste to enter the containment system will not re-occur [WAC 173-303-320(3)].

E. If the source of the dangerous and/or mixed waste is determined to be a leak from the primary HLW Vitrification System into the secondary containment system, or the system is unfit for use as determined through an integrity assessment or other inspection, the Permittees ~~shall~~ will comply with the requirements of WAC 173-303-640(7) and take the following actions:

1. Close the HLW Vitrification System Sub-system following procedures in WAC 173-303-640(7)(e)(i), in accordance with WAC 173-303-680 and Operating Unit 10, Chapter 11.0 of this Permit, as approved pursuant to Permit Condition III.10.C.8., or

2. Repair and re-certify (in accordance with WAC 173-303-810(13)(a), as modified pursuant to Permit Condition III.10.J.1.a.iii.) the HLW

Vitrification System in accordance with Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e.v., before the HLW Vitrification System is placed back into service [WAC 173-303-640(7)(e)(iii) and WAC 173-303-640(7)(f), in accordance with WAC 173-303-680].

F. The Permittees ~~shall~~ will document, in the WTP Unit operating record, actions/procedures taken to comply with A. through E. above, as specified in WAC 173-303-640(6)(d), in accordance with WAC 173-303-680(2) and (3).

G. In accordance with WAC 173-303-680(2) and WAC 173-303-680 (3), the Permittees ~~shall~~ will notify and report releases to the environment to Ecology, as specified in WAC 173-303-640(7)(d).

III.10.J.1.a.xxiv. If liquids (e.g., dangerous and/or mixed waste leaks and spills, precipitation, fire water, liquids from damaged or broken pipes) cannot be removed from the secondary containment system within twenty-four (24) hours, Ecology will be verbally notified within twenty-four (24) hours of discovery. The notification ~~shall~~ will provide the information in A, B, and C, listed below. The Permittees ~~shall~~ will provide Ecology with a written demonstration within seven (7) business days, identifying at a minimum [WAC 173-303-640(4)(c)(iv) and WAC 173-303-640(7)(b)(ii), in accordance with WAC 173-303-680(3) and WAC 173-303-806(4)(i)(i)(B)]:

A. Reasons for delayed removal;

B. Measures implemented to ensure continued protection of human health and the environment;

C. Current actions being taken to remove liquids from secondary containment.

III.10.J.1.a.xxv. All air pollution control devices and capture systems in the HLW Vitrification System ~~shall~~ will be maintained and operated at all times in a manner so as to minimize the emissions of air contaminants and to minimize process upsets. Procedures for ensuring that the air pollution control devices and capture systems in the HLW Vitrification System are properly operated and maintained so as to minimize the emission of air contaminants and process upsets ~~shall~~ will be established.

III.10.J.1.a.xxvi. In all future narrative permit submittals, the Permittees ~~shall~~ will include HLW Vitrification sub-system names with the sub-system designation.

III.10.J.1.a.xxvii. Modifications to approved design, plans, and specifications in Operating Unit 10 of this Permit for the HLW Vitrification System ~~shall~~ will be allowed only in accordance with Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g., III.10.C.9.d., e., and h.

III.10.J.1.a.xxviii. For any portion of the HLW Vitrification System that has the potential for formation and accumulation of hydrogen gases, the Permittees ~~shall~~ will operate the portion to maintain hydrogen levels below the lower explosive limit [WAC 173-303-815(2)(b)(ii)].

III.10.J.1.a.xxix. For each HLW Vitrification System sub-system holding dangerous waste which are acutely or chronically toxic by inhalation, the Permittees ~~shall~~ will operate the system to prevent escape of vapors, fumes or other emissions into the air [WAC 173-303-806(4)(i)(i)(B) and WAC 173-303-640(5)(e) in accordance with WAC 173-303-680].

III.10.J.1.b. Performance Standards

III.10.J.1.b.i. The HLW Vitrification System must achieve a destruction and removal efficiency (DRE) of 99.99% for the principal organic dangerous constituents (PODCs) listed below [40 CFR §63.1203(c)(1) and 40CFR 63.1203(c)(2), in accordance with WAC 173-303-680(2)].

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DRE in this Permit condition ~~shall~~ will be calculated in accordance with the formula given below:

DRE=[1-(Wout/Win)] x 100%

Where:

Win=mass feedrate of one principal organic dangerous constituent (PODC) in a waste feedstream; and

Wout=mass emission rate of the same PODC present in exhaust emissions prior to release to the atmosphere.

III.10.J.1.b.ii. Particulate matter emissions from the HLW Vitrification System ~~shall~~ will not exceed 34 mg/dscm (0.015 grains/dscf) [40 CFR §63.1203(b)(7), in accordance with WAC 173-303-680(2)];

III.10.J.1.b.iii. Hydrochloric acid and chlorine gas emissions from the HLW Vitrification System ~~shall~~ will not exceed 21 ppmv, combined [40 CFR §63.1203(b)(6), in accordance with WAC 173-303-680(2)];

III.10.J.1.b.iv. Dioxin and Furan TEQ emissions from the HLW Vitrification System ~~shall~~ will not exceed 0.2 nanograms (ng)/dscm [40 CFR §63.1203(b)(1), in accordance with WAC 173-303-680(2)];

III.10.J.1.b.v. Mercury emissions from the HLW Vitrification System ~~shall~~ will not exceed 45 µg/dscm, [40 CFR §63.1203(b)(2), in accordance with WAC 173-303-680(2)].

III.10.J.1.b.vi. Lead and cadmium emissions from the HLW Vitrification System ~~shall~~ will not exceed 120 µg/dscm, combined [40 CFR §63.1203(b)(3), in accordance with WAC 173-303-680(2)].

III.10.J.1.b.vii. Arsenic, beryllium, and chromium emissions from the HLW Vitrification System ~~shall~~ will not exceed 97 µg/dscm, combined [40 CFR §63.1203(b)(4), in accordance with WAC 173-303-680(2)].

III.10.J.1.b.viii. Carbon monoxide (CO) emission from the HLW Vitrification System ~~shall~~ will not exceed 100 parts per million (ppm) by volume, over an hourly rolling average (as measured and recorded by the continuous monitoring system), dry [40 CFR §63.1203(b)(5)(i), in accordance with WAC 173-303-680(2)].

III.10.J.1.b.ix. Hydrocarbon emission from the HLW Vitrification System ~~shall~~ will not exceed 10 parts per million (ppm) by volume, over an hourly rolling average (as measured and recorded by the continuous monitoring system during demonstration testing required by this Permit), dry basis, and reported as propane [40 CFR §63.1203(b)(5)(ii), in accordance with WAC 173-303-680(2)];

III.10.J.1.b.x. If the emissions from the HLW Vitrification System exceed the emission rates listed in Permit Table III.10.J.E, as approved pursuant to Permit Condition III.10.C.11.b., the Permittees ~~shall~~ will notify Ecology, in accordance with Permit Condition III.10.J.3.d.vii. [WAC 173-303-680(2) and (3), and WAC 173-303-815(2)(b)(ii)].

The emission limits specified in Permit Conditions III.10.J.1.b.i. through III.10.J.1.b.x. above, ~~shall~~ will be met for the HLW Vitrification System by limiting feed rates as specified in Permit Tables III.10.J.D and III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., compliance with operating conditions specified in Permit Condition III.10.J.1.c. (except as specified in Permit Condition III.10.J.1.b.xii.), and compliance with Permit Condition III.10.J.1.b.xi.

III.10.J.1.b.xi. Treatment effectiveness, feed-rates and operating rates for dangerous and mixed waste management units contained in the HLW Building, but not included in Permit Table III.10.J.A, as approved/modified pursuant to Permit Condition III.10.J.5., ~~shall~~ will be as specified in Permit Sections III.10.D, III.10.E, III.10.F and consistent with assumptions and basis which are reflected in Operating Unit 10, Appendix 6.3.1 of this Permit, as approved pursuant to Permit Condition III.10.C.11.b. For the purposes of this permit condition, Operating Unit 10, Appendix 6.3.1 ~~shall~~ will be superceded by Appendix 6.4.1 upon its approval pursuant to either Permit Conditions III.10.C.11.c. or III.10.C.11.d. [WAC 173-303-680(2) and (3), and WAC 173-303-815(2)(b)(ii)].

III.10.J.1.b.xii. Compliance with the operating conditions specified in Permit Condition III.10.J.1.c., ~~shall~~ will be regarded as compliance with the required performance standards identified in Permit Conditions III.10.J.1.b.i. through x. However, if it is determined that during the effective period of this Permit that compliance with the operating conditions in Permit Condition III.10.J.1.c. is not sufficient to ensure compliance with the performance standards specified in Permit Conditions III.10.J.1.b.i. through x., the Permit may be modified, revoked, or reissued pursuant to Permit Conditions III.10.C.2.e. and III.10.C.2.f., or III.10.C.2.g.

III.10.J.1.c. Operating Conditions [WAC-303-670(6), in accordance with WAC 173-303-680(2)and (3)].

The Permittees ~~shall~~ will operate the HLW Vitrification System in accordance with Operating Unit 10, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., and Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e., and Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., except as modified pursuant to Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., III.10.J.4., and in accordance with the following:

III.10.J.1.c.i. The Permittees ~~shall~~ will operate the HLW Vitrification System in order to maintain the systems and process parameters listed in Permit Tables III.10.J.C and III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., within the set-points specified in Permit Table III.10.J.F.

III.10.J.1.c.ii. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., to automatically cut-off and/or lock-out the dangerous and mixed waste feed to the HLW Vitrification System when the monitored operating conditions deviate from the set-points specified in Permit Table III.10.J.F.

III.10.J.1.c.iii. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., to automatically cut-off and/or lock-out the dangerous and mixed waste feed to the HLW Vitrification System when all instruments specified on Permit Table III.10.H.F for measuring the monitored parameters fails or exceeds its span value.

III.10.J.1.c.iv. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., to automatically cut-off and/or lock out the dangerous and/or mixed waste feed to the HLW Vitrification System when any portion of the HLW Vitrification System is bypassed. The terms "bypassed" and "bypass event" as used in Permit Sections III.10.J and III.10.K ~~shall~~ will mean if any portion of the HLW Vitrification System is bypassed so that gases are not treated as during the Demonstration Test.

III.10.J.1.c.v. In the event of a malfunction of the AWFCO systems listed in Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., the Permittees ~~shall~~ will immediately, manually cut-off the dangerous and mixed waste feed to the HLW Vitrification System. The Permittees ~~shall~~ will not restart the dangerous and/or mixed waste feed until the problem causing the malfunction has been identified and corrected.

III.10.J.1.c.vi. The Permittees ~~shall~~ will manually cut-off the dangerous and mixed waste feed to the HLW Vitrification System when the operating conditions deviate from the limits specified in Permit Condition III.10.J.1.c.i., unless the deviation automatically activates the waste feed cut-off sequence specified in Permit Conditions III.10.J.1.c.ii., III.10.J.1.c.iii., and/or III.10.J.1.c.iv.

III.10.J.1.c.vii. If greater than thirty (30) dangerous and mixed waste feed cut-off, combined, to the HLW Vitrification System occur due to deviations from Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5., within a sixty (60) day period, the Permittees ~~shall~~ will submit a written report to Ecology within five (5) calendar days of the thirty-first exceedence including the information specified below. These dangerous and mixed waste feed cut-offs to the HLW Vitrification System, whether automatically or manually activated, are counted if the specified set-points are deviated from while dangerous waste, mixed waste, and waste residues continue to be processed in the HLW Vitrification System. A cascade event is counted at a frequency of one (1) towards the first waste feed cut-off parameter, specified on Permit Table III.10.J.F, from which the set-point is deviated:

A. The parameter(s) that deviated from the set-point(s) in Permit Table III.10.J.F;

B. The magnitude, dates, and duration of the deviations;

C. Results of the investigation of the cause of the deviations; and

D. Corrective measures taken to minimize future occurrences of the deviations.

III.10.J.1.c.viii. If any portion of the HLW Vitrification System is bypassed while treating dangerous and/or mixed waste, it ~~shall~~ will be regarded as non-compliance with the operating conditions specified in Permit Condition III.10.J.1.c. and the performance standards specified in Permit Condition III.10.J.1.b. After such a bypass event, the Permittees ~~shall~~ will perform the following actions:

A. Investigate the cause of the bypass event;

B. Take appropriate corrective measures to minimize future bypasses;

C. Record the investigation findings and corrective measures in the operating record; and

D. Submit a written report to Ecology within five (5) days of the bypass event documenting the result of the investigation and corrective measures.

III.10.J.1.c.ix. The Permittees ~~shall~~ will control fugitive emissions from the HLW Vitrification System by maintaining the melter under negative pressure.

III.10.J.1.c.x. Compliance with the operating conditions specified in Permit Condition III.10.J.1.c. ~~shall~~ will be regarded as compliance with the required performance standards identified in Permit Condition III.10.J.1.b. However, evidence that compliance with these operating conditions is insufficient to ensure compliance with the performance standards, ~~shall~~ will justify modification, revocation, or re-issuance of this Permit, in accordance with Permit Conditions III.10.C.2.e. and III.10.C.2.f., or III.10.C.2.g.

III.10.J.1.d. Inspection Requirements [WAC 173-303-680(3)].

III.10.J.1.d.i. The Permittees ~~shall~~ will inspect the HLW Vitrification System in accordance with the Inspection Schedules in Operating Unit 10, Chapter 6.0 of this Permit, as modified in accordance with Permit Condition III.10.C.5.c.

III.10.J.1.d.ii. The inspection data for HLW Vitrification System ~~shall~~ will be recorded, and the records ~~shall~~ will be placed in the WTP Unit operating record for the HLW Vitrification System, in accordance with Permit Condition III.10.C.4.

III.10.J.1.d.iii. The Permittees ~~shall~~ will comply with the inspection requirements specified in Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., and III.10.J.4.

III.10.J.1.e. Monitoring Requirements [WAC 173-303-670(5), WAC 173-303-670(6), WAC -173-303-670(7), and WAC 173-303-807(2), in accordance with WAC 173-303-680(3)]

III.10.J.1.e.i. Upon receipt of a written request from Ecology, the Permittees ~~shall~~ will perform sampling and analysis of the dangerous and mixed waste and exhaust emissions to verify that the operating requirements established in the Permit achieve the performance standards delineated in this Permit.

III.10.J.1.e.ii. The Permittees ~~shall~~ will comply with the monitoring requirements specified in Operating Unit 10, Appendices 10.2, 10.3, 10.7, 10.13, 10.15, and 10.18 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.c., III.10.J.5.d., III.10.J.5.e., and III.10.J.5.f., as modified by Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., and III.10.J.4.

III.10.J.1.e.iii. The Permittees ~~shall~~ will operate, calibrate, and maintain the carbon monoxide and hydrocarbon continuous emission monitors (CEM) specified in this Permit in accordance with Performance Specification 4B and 8A of 40 CFR Part 60, Appendix B, in accordance with Appendix to Subpart EEE of 40 CFR Part 63, and Operating Unit 10 Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., and III.10.J.4.

III.10.J.1.e.iv. The Permittees ~~shall~~ will operate, calibrate, and maintain the instruments specified on Permit Tables III.10.J.C and F, as approved/modified pursuant to Permit Condition III.10.J.5., in accordance with Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., and III.10.J.4.

III.10.J.1.f. Recordkeeping Requirements [WAC 173-303-380 and WAC 173-303-680(3)]

III.10.J.1.f.i. The Permittees ~~shall~~ will record and maintain in the WTP Unit operating record for the HLW Vitrification System, all monitoring, calibration, maintenance, test data, and inspection data compiled under the conditions of this Permit, in accordance with Permit Conditions III.10.C.4. and III.10.C.5., as modified by Permit Conditions III.10.J.1.b.xii., III.10.J.2., III.10.J.3., and III.10.J.4.

III.10.J.1.f.ii. The Permittees ~~shall~~ will record in the WTP Unit operating record the date, time, and duration of all automatic waste feed cut-offs and/or lockouts, including the triggering parameters, reason for the deviation, and recurrence of the incident. The Permittees ~~shall~~ will also record all incidents of AWFCO system function failures, including the corrective measures taken to correct the condition that caused the failure.

III.10.J.1.f.iii. The Permittees ~~shall~~ will submit to Ecology a report semi-annually the first calendar year, and annually thereafter each calendar year within ninety (90) days following the end of the year. The report will include the following information:

A. Total dangerous and mixed waste feed processing time for the HLW Vitrification System;

B. Date/Time of all HLW Vitrification System startups and shutdowns;

C. Date/Time/Duration/Cause/Corrective Action taken for all HLW Vitrification System shutdowns caused by malfunction of either process or control equipment; and

D. Date/Time/Duration/Cause/Corrective Action taken for all instances of dangerous and/or mixed waste feed cut-off due to deviations from Permit Table III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5.

III.10.J.1.f.iv. The Permittees ~~shall~~ will submit an annual report to Ecology each calendar year within ninety (90) days following the end of the year of all quarterly CEM Calibration Error and Annual CEM Performance Specification Tests conducted in accordance with Permit Condition III.10.J.1.e.iii.

III.10.J.1.g. Closure

The Permittees ~~shall~~ will close the HLW Vitrification System in accordance with Operating Unit 10, Chapter 11.0 of this Permit, as approved pursuant to Permit Condition III.10.C.8.

III.10.J.2. Shakedown Period [WAC 173-303-670(5), WAC 173-303-670(6), WAC -173-303-670(7), and WAC 173-303-807(2), in accordance with WAC 173-303-680(2) and (3)].

III.10.J.2.a. The shakedown period for the HLW Vitrification System ~~shall~~ will be conducted in accordance with Permit Condition III.10.J.1., Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified in accordance with Permit Conditions III.10.J.1.b.xii., III.10.J.2., and III.10.J.3.

III.10.J.2.b. Duration of the Shakedown Period

III.10.J.2.b.i. The shakedown period for the HLW Vitrification System ~~shall~~ will begin with the initial introduction of dangerous waste in the HLW Vitrification System following construction and ~~shall~~ will end with the start of the demonstration test.

III.10.J.2.b.ii. The shakedown period ~~shall~~ will not exceed the following limits, as defined by hours of operation of the HLW Vitrification System with dangerous waste. The Permittees may petition Ecology for one (1) extension of each shakedown phase for seven hundred and twenty (720) additional operating hours in accordance with permit modification procedures specified in Permit Conditions III.10.C.2.e. and III.10.C.2.f.

Shakedown Phase 1: 720 hours

Shakedown Phase 2: 720 hours

III.10.J.2.b.iii. Shakedown Phase 2 ~~shall~~ will not be commenced until documentation has been submitted to Ecology verifying that the HLW Vitrification System has operated at a minimum of 75% of the shakedown Phase 1 feed-rate limit for two (2) separate eight (8) consecutive hour periods with no AWFCOs.

III.10.J.2.c. Allowable Waste Feed During the Shakedown Period

III.10.J.2.c.i. The Permittees may feed the dangerous waste specified for the HLW Vitrification System on the Part A Forms (Operating Unit 10, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Operating Unit 10, Chapter 3.0 of this Permit, as approved pursuant to Permit Condition III.10.C.3., except Permit Conditions III.10.J.2.c.ii. through v. also apply.

III.10.J.2.c.ii. The Permittees ~~shall~~ will not feed the following waste to the HLW Vitrification System during Shakedown Phase 1:

A. Acutely toxic dangerous waste listed in WAC 173-303-081(a)(2)(a)(i).

B. Mixed waste

III.10.J.2.c.iii. The Permittees ~~shall~~ will not feed the following waste to the HLW Vitrification System during Shakedown Phase 2:

A. Mixed waste

III.10.J.2.c.iv. The feed-rates to the HLW Vitrification System ~~shall~~ will not exceed the limits in Permit Tables III.10.J.D and III.10.J.F, as approved/modified pursuant to Permit Condition III.10.J.5.

III.10.J.2.c.v. The Permittees ~~shall~~ will conduct sufficient analysis of the dangerous waste treated in the HLW Vitrification System to verify that the waste feed is within the physical and chemical composition limits specified in this Permit.

III.10.J.3. Demonstration Test Period [WAC 173-303-670(5), WAC 173-303-670(6), WAC 173-303-670(7), and WAC 173-303-807(2), in accordance with WAC 173-303-680(2) and (3)]

III.10.J.3.a. Demonstration Test Period

III.10.J.3.a.i. The Permittees ~~shall~~ will operate, monitor, and maintain the HLW Vitrification System as specified in Permit Condition III.10.J.1., and Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., except as modified in accordance with Permit Conditions III.10.J.1.b.xii. and III.10.J.3.

III.10.J.3.a.ii. Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., ~~shall~~ will be re-submitted to Ecology for approval by the Permittees as a permit modification pursuant to Permit Conditions III.10.C.2.e. and III.10.C.2.f. at least one hundred and eighty (180) days prior to the start date of the demonstration test. The revised Demonstration Test Plan ~~shall~~ will include applicable EPA promulgated test methods and procedures in effect at the time of the re-submittal and projected commencement and completion dates for the Demonstration Test.

III.10.J.3.a.iii. The Permittees ~~shall~~ will not commence the demonstration test period until documentation has been submitted to Ecology verifying that the HLW Vitrification System has operated at a minimum of 90% of the demonstration test period feed-rate limit for a minimum of an eight (8) consecutive hours period on two (2) consecutive days.

III.10.J.3.b. Performance Standards

The Permittees ~~shall~~ will demonstrate compliance with the performance standards specified in Permit Condition III.10.J.1.b. during the Demonstration Test Period.

III.10.J.3.c. Allowable Waste Feed During the Demonstration Test Period

III.10.J.3.c.i. The Permittees may feed the dangerous waste specified for the HLW Vitrification System in Part A Forms (Operating Unit 10, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Operating Unit 10, Chapter 3.0 of this Permit, as approved pursuant to Permit Condition III.10.C.3., except Permit Conditions III.10.J.3.c.ii. through iv. also apply.

III.10.J.3.c.ii. The Permittees ~~shall~~ will not feed mixed waste to the HLW Vitrification System.

III.10.J.3.c.iv. The dangerous waste feed-rates to the HLW Vitrification System ~~shall~~ will not exceed the limits in Permit Tables III.10.J.D and F, as approved/modified pursuant to Permit Condition III.10.J.5.

III.10.J.3.c.v. The Permittees ~~shall~~ will conduct sufficient analysis of the dangerous waste treated in the HLW Vitrification System to verify that the dangerous waste is within the physical and chemical composition limits specified in this Permit.

III.10.J.3.d. Demonstration Data Submissions and Certifications

III.10.J.3.d.i. The Permittees ~~shall~~ will submit to Ecology a complete demonstration test report within one hundred and twenty (120) calendar days of completion of the Demonstration Test including all data collected during the Demonstration Test and updated Permit Tables III.10.K.D, III.10.K.E, and III.10.K.F.

III.10.J.3.d.ii. The Permittees must submit the following information to Ecology prior to receiving Ecology's approval to commence feed of dangerous waste and mixed waste to the HLW Vitrification System:

A. The Permittees ~~shall~~ will submit a summary of data collected as required during the Demonstration Test to Ecology upon completion of the Demonstration Test.

B. A certification that the Demonstration Test has been carried out in accordance with the approved Demonstration Test Plan and approved modifications within thirty (30) days of the completion of the Demonstration Test [WAC 173-303-807(8)].

C. Calculations and analytical data showing compliance with the performance standards specified in Permit Conditions III.10.J.1.b.i, III.10.J.1.b.iv, III.10.J.1.b.v, III.10.J.1.b.vi, and III.10.J.1.b.vii

D. Laboratory data QA/QC summary for the information provided in III.10.J.3.d.ii.C.

III.10.J.3.d.iii. After successful completion of the Demonstration Test and receipt of Ecology's approval, the Permittees ~~shall~~ will be authorized to commence feed of dangerous waste and mixed waste to the HLW Vitrification System for the post-demonstration test period indicated in Permit Tables III.10.J.D and F, as approved/modified pursuant to Permit Condition III.10.J.5., in compliance with the operating requirements specified in Permit Condition III.10.J.1.c. and within the limitations specified in Permit Condition III.10.C.14.

III.10.J.3.d.iv. RESERVED

III.10.J.3.d.v. After successful completion of the Demonstration Test, Permittees submittal of the following to Ecology, and Permittees receipt of Ecology approval of the following in writing, the Permittees ~~shall~~ will be authorized to feed dangerous waste and mixed waste to the HLW Vitrification System pursuant to Permit Section III.10.K:

A. A complete Demonstration Test Report for the HLW Vitrification System and updated Permit Tables III.10.K.D, III.10.K.E, and III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.10.C.11.c. or III.10.C.11.d., the test report ~~shall~~ will be certified in accordance with WAC 173-303-807(8), in accordance with WAC 173-303-680(2) and (3).

B. A Final Risk Assessment Report completed pursuant to Permit Conditions III.10.C.11.c. or III.10.C.11.d.

III.10.J.3.d.vi. If any calculations or testing results show that one or more of the performance standards listed in Permit Condition III.10.J.1.b., with the exception of Permit Condition III.10.J.1.b.x., for the HLW Vitrification System were not met during the Demonstration Test, the Permittees ~~shall~~ will perform the following actions:

A. Immediately stop dangerous and mixed waste feed to the HLW Vitrification System under the mode of operation that resulted in not meeting the performance standard(s).

B. Verbally notify Ecology within twenty-four (24) hours of discovery of not meeting the performance standard(s) as specified in Permit Condition I.E.21.

C. Investigate the cause of the failure and submit a report of the investigation findings to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s).

D. Submit to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s), documentation supporting a mode of operation where all performance standards listed in Permit Condition III.10.J.1.b., with the exception of Permit Condition III.10.J.1.b.x., for the HLW Vitrification System were met during the demonstration test, if any such mode was demonstrated.

E. Based on the information provided to Ecology by the Permittees, pursuant to Permit Conditions III.10.J.3.d.vi.A through D above, and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the LAW Vitrification System and/or amend the mode of operation the Permittees are allowed to continue operations prior to Ecology approval of a compliance schedule and/or revised Demonstration Test Plan, pursuant to Permit Conditions III.10.J.3.d.vi.F and G.

F. If the performance standard listed in Permit Condition III.10.J.1.b.i. was not met during the Demonstration Test, the Permittees ~~shall~~ will submit within one hundred and twenty (120) days of discovery of not meeting the performance standard, a revised Demonstration Test Plan (if appropriate) and a compliance schedule for Ecology approval to address this deficiency. If a revised Demonstration Test Plan is submitted, it ~~shall~~ will be accompanied by a request for approval to retest as a permit modification pursuant to Permit Conditions III.10.C.2.e. and III.10.C.2.f. The revised Demonstration Test Plan (if submitted) must include substantive changes to prevent failure from reoccurring.

G. If any of the performance standards listed in Permit Condition III.10.J.1.b., with the exception of Permit Conditions III.10.J.1.b.i. or III.10.J.1.b.x., were not met during the Demonstration Test, the Permittees ~~shall~~ will submit to Ecology within one hundred and twenty (120) days of discovery of not meeting the performance standard(s), a revised Demonstration Test Plan requesting approval to retest as a permit modification pursuant to Permit Conditions III.10.C.2.e. and III.10.C.2.f. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring.

III.10.J.3.d.vii. If any calculations or testing results show that any emission rate for any constituent listed in Permit Table III.10.J.E, as approved pursuant to Permit Condition III.10.C.11.b., is exceeded for HLW Vitrification System during the Demonstration Test, the Permittees ~~shall~~ will perform the following actions:

A. Verbally notify Ecology within twenty-four (24) hours of the discovery of exceeding the emission rate(s) as specified in Permit Condition I.E.21.

B. Submit to Ecology additional risk information to indicate that the increased emissions impact is offset by decreased emission impact from one or more constituents expected to be emitted at the same time, and/or investigate the cause and impact of the exceedence of the emission rate(s) and submit a report of the investigation findings to Ecology within fifteen (15) days of the discovery of exceeding the emission rate(s); and,

C. Based on the notification and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or to submit a revised Demonstration Test Plan as a permit modification pursuant to Permit Conditions III.10.C.2.e. and III.10.C.2.f., or III.10.C.2.g. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring.

III.10.J.4. Post-Demonstration Test Period [WAC 173-303-670(5), WAC 173-303-670(6), and WAC 173-303-807(2), in accordance with WAC 173-303-680(2) and (3)].

III.10.J.4.a. The Permittees ~~shall~~ will operate, monitor, and maintain the HLW Vitrification System as specified in Permit Condition III.10.J.1. and Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5., except as modified in accordance with Permit Conditions III.10.J.1.b.xii., III.10.J.3., and III.10.J.4.

III.10.J.4.b. Allowable Waste Feed During the Post-Demonstration Test Period

III.10.J.4.b.i. The Permittees may feed the dangerous and/or mixed waste specified for the HLW Vitrification System on the Part A Forms (Operating Unit 10, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Operating Unit 10, Chapter 3.0 of this Permit, as approved pursuant to Permit Condition III.10.C.3., and except Permit Conditions III.10.J.4.b.ii. and III.10.J.4.b.iii. also apply.

III.10.J.4.b.ii. The dangerous waste and mixed waste feed rates to the HLW Vitrification System ~~shall~~ will not exceed the limits in Permit Tables III.10.J.D and F, as approved/modified pursuant to Permit Condition III.10.J.5., or in Permit Condition III.10.J.3.

III.10.J.4.b.iii. The Permittees ~~shall~~ will conduct sufficient analysis of the dangerous waste and mixed waste treated in HLW Vitrification System to verify that the waste feed is within the physical and chemical composition limits specified in this Permit.

III.10.J.5. Compliance Schedules

III.10.J.5.a. All information identified for submittal to Ecology in a. through f. of this compliance schedule must be signed and certified in accordance with requirements in WAC 173-303-810(12), as modified in accordance with Permit Condition III.10.J.1.a.iii. [WAC 173-303-806(4)].

III.10.J.5.b. The Permittees ~~shall~~ will submit to Ecology, pursuant to Permit Condition III.10.C.9.f., prior to construction of each secondary containment and leak detection system for the HLW Vitrification System (per level) as identified in Permit Tables III.10.J.A and III.10.J.B, engineering information as specified below, for incorporation into Operating Unit 10, Appendices 10.2, 10.4, 10.5, 10.7, 10.8, 10.9, 10.11, and 10.12 of this Permit. At a minimum, engineering information specified below will show the following as described in WAC 173-303-640, in accordance with WAC 173-303-680 (the information specified below will include dimensioned engineering drawings and information on sumps and floor drains):

III.10.J.5.b.i. IQRPE Reports (specific to foundation, secondary containment, and leak detection system) ~~shall~~ will include review of design drawings, calculations, and other information on which the certification report is based and ~~shall~~ will include, but not limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Operating Unit 10, Appendix 10.0 of this Permit, may be included in the report by reference and should include drawing and document numbers. IQRPE Reports ~~shall~~ will be consistent with the information separately provided in ii. through ix. below [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)];

III.10.J.5.b.ii. Design drawings (General Arrangement Drawings, plan and cross sections) and specifications for the foundation, secondary containment including liner installation details, and leak detection methodology. These items should show the dimensions, volume calculations, and location of the secondary containment system, and should include items such as floor/pipe slopes to sumps, tanks, floor drains [WAC 173-303-640(4)(b) through (f) and WAC 173-303-640(3)(a), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)];

III.10.J.5.b.iii. The Permittees ~~shall~~ will provide the design criteria (references to codes and standards, load definitions, and load combinations, materials of construction, and analysis/design methodology) and typical design details for the support of the secondary containment system. This information ~~shall~~ will demonstrate the foundation will be capable of providing support to the secondary containment system, resistance to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift [WAC 173-303-640(4)(c)(ii), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.b.iv. A description of materials and equipment used to provide corrosion protection for external metal components in contact with soil, including factors affecting the potential for corrosion [WAC 173-303-640(3)(a)(iii)(B), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(A) through (B)];

III.10.J.5.b.v. Secondary containment/foundation, and leak detection system, materials selection documentation (including, but not limited to, concrete coatings and water stops, and liner materials), as applicable [WAC 173-303-806(4)(i)(i)(A) through (B)];

III.10.J.5.b.vi Detailed description of how the secondary containment for the HLW Vitrification System will be installed in compliance with WAC 173-303-640(3)(c), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(A) through (B);

III.10.J.5.b.vii. Submit Permit Tables III.10.J.B and III.10.K.B completed to provide for all secondary containment sumps and floor drains the information, as specified in each column heading consistent with information to be provided in i. through vi., above;

III.10.J.5.b.viii. Documentation that secondary containment and leak detection systems will not accumulate hydrogen gas levels above the lower explosive limit for incorporation into the Administrative Record [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.b.ix. A detailed description of how HLW Vitrification System design provides access for conducting future HLW Vitrification System integrity assessments [WAC 173-303-640(3)(b) and WAC 173-303-806(4)(i)(i)(B)].

III.10.J.5.c. The Permittees ~~shall~~ will submit to Ecology pursuant to Permit Condition III.10.C.9.f., prior to installation of each sub-system as identified in Permit Table III.10.J.A, engineering information as specified below, for incorporation into Operating Unit 10, Appendices 10.1 through 10.14 and 10.17 of this Permit. At a minimum, engineering information specified below will show the following, as required pursuant to WAC 173-303-640, in accordance with WAC 173-303-680 (the information specified below will include dimensioned engineering drawings):

III.10.J.5.c.i. IQRPE Reports (specific to sub-system) ~~shall~~ will include review of design drawings, calculations, and other information on which the certification report is based and ~~shall~~ will include as applicable, but not limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Operating Unit 10, Appendix 10.0 of this Permit, may be included in the report by reference and should include drawing and document numbers. The IQRPE Reports ~~shall~~ will be consistent with the information separately provided in ii. through xii. below and the IQRPE Report specified in Permit Condition III.10.J.5.b. [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)];

III.10.J.5.c.ii. Design drawings [General Arrangement Drawings in plan and cross section, Process Flow Diagrams, Piping and Instrumentation Diagrams, (including pressure control systems), Mechanical Drawings, and specifications, and other information specific to subsystems (to show location and physical attributes of each subsystem specific to miscellaneous units)] [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)];

III.10.J.5.c.iii. Sub-system design criteria (references to codes and, standards, load definitions, and load combinations, materials of construction, and analysis/design methodology) and typical design details to support the sub-systems. Structural support calculations specific to off-specification, non-standard, and field-fabricated subsystems ~~shall~~ will be submitted for incorporation into the Administrative Record. Documentation ~~shall~~ will include, but not be limited to, supporting specifications (test data, treatment effectiveness report, etc.), supporting projected operational capability (e.g., WESP projected removal efficiency for individual metals, halogens, particulates, etc.), and compliance with performance standards specified in Permit Condition III.10.J.1.b [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.c.iv. A description of materials and equipment used to provide corrosion protection for external metal components in contact with water, including factors affecting the potential for corrosion [WAC 173-303-640(3)(a)(iii)(B), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(A) through (B)];

III.10.J.5.c.v. Sub-system materials selection documentation (e.g., physical and chemical tolerances) [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(A)];

III.10.J.5.c.vi. Sub-system vendor information (including, but not limited to, required performance warranties, as available), consistent with information submitted under ii. above, ~~shall~~ will be submitted for incorporation into the Administrative Record [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(A) through (B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.c.vii. System descriptions ~~(process)~~ related to sub-system units ~~shall~~ will be submitted for incorporation into the Administrative Record [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A) through (B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.c.viii. Mass and energy balance for normal projected operating conditions used in developing the Piping and Instrumentation Diagrams and Process Flow Diagrams, including assumptions and formulas used to complete the mass and energy balance, so that they can be independently verified for incorporation into the Administrative Record [WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.c.ix. Detailed description of all potential HLW Vitrification System bypass events including:

A. A report which includes an analysis of credible potential bypass events and recommendations for prevention/minimization of the potential, impact, and frequency of the bypass event to include at a minimum:

1. Operating procedures
2. Maintenance procedures
3. Redundant equipment
4. Redundant instrumentation
5. Alternate equipment
6. Alternate materials of construction

III.10.J.5.c.x. A detailed description of how the sub-systems will be installed in compliance with WAC 173-303-640(3)(b), (c), (d), and (e), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B);

III.10.J.5.c.xi. Sub-system design to prevent escape of vapors and emissions of acutely or chronically toxic (upon inhalation) EHW, for incorporation into the Administrative Record [WAC 173-303-640(5)(e), in accordance with WAC 173-303-680, (2), and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.c.xii. Documentation that sub-systems are designed to prevent the accumulation of hydrogen gases levels above the lower explosive limit for incorporation into the Administrative Record [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.d. The Permittees ~~shall~~ will submit to Ecology, pursuant to Permit Condition III.10.C.9.f., prior to installation of equipment for each sub-system as identified in Permit Tables III.10.J.A and III.10.J.B, not addressed in Permit Conditions III.10.J.5.b. or III.10.J.5.c., engineering information as specified below, for incorporation into Operating Unit 10, Appendices 10.1 through 10.14 of this Permit. At a minimum, engineering information specified below will show the following as required pursuant to in WAC 173-303-640, in accordance with WAC 173-303-680 (the information specified below will include dimensioned engineering drawings):

III.10.J.5.d.i. IQRPE Reports (specific to sub-system equipment) ~~shall~~ will include a review of design drawings, calculations, and other information as applicable on which the certification report is based. The reports ~~shall~~ will include, but not be limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Operating Unit 10, Appendix 10.0 of this Permit, may be included in the report by reference and should include drawing and document numbers. The IQRPE Reports ~~shall~~ will be consistent with the information provided separately in ii. through xiii. below and the IQRPE Reports specified in Permit Conditions III.10.J.5.b. and III.10.J.5.c. [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(I)(I)(A) through (B)];

III.10.J.5.d.ii. Design drawings [Process Flow Diagrams, Piping and Instrumentation Diagrams (including pressure control systems), and specifications, and other information specific to equipment (these drawings should include all equipment such as pipes, valves, fittings, pumps, instruments, etc.)] [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(A) through (B)];

III.10.J.5.d.iii. Sub-system equipment design criteria (references to codes and standards, load definitions and load combinations, materials of construction, and analysis/design methodology) and typical design details for the support of the sub-system equipment. [WAC 173-303-640(3)(a) and WAC 173-303-640(3)(f), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.d.iv. A description of materials and equipment used to provide corrosion protection for external metal components in contact with soil and water, including factors affecting the potential for corrosion [WAC 173-303-640(3)(a)(iii)(B), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(A)];

III.10.J.5.d.v. Materials selection documentation for equipment for each sub-system (e.g., physical and chemical tolerances) [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2) and WAC 173-303-806(4)(i)(i)(A)];

III.10.J.5.d.vi. Vendor information (including, but not limited to, required performance warranties, as available), consistent with information submitted under ii. above, for sub-system equipment ~~shall~~ will ~~for equipment shall~~ be submitted for incorporation into the Administrative Record [WAC 173-303-640(3)(a), in accordance with WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(A) through (B), and WAC 173-303-806(4)(i)(iv)];

III.10.J.5.d.vii. Sub-system, sub-system equipment, and leak detection system instrument control logic narrative description (e.g., software functional specifications, descriptions of fail-safe conditions, etc.) [WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.d.viii. System description ~~(process)~~ related to sub-system equipment, and system descriptions related to leak detection systems, (including instrument control logic and narrative descriptions), for incorporation into the Administrative Record [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A) through (B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.d.ix. A detailed description of how the sub-system equipment will be installed and tested [WAC 173-303-640(3)(c) through (e) and WAC 173-303-640(4)(b) and (c), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.d.x. For process monitoring, control, and leak detection system instrumentation for the HLW Vitrification System as identified in Permit Tables III.10.J.C. and III.10.J. F., a detailed description of how the process monitoring, control, and leak detection system instrumentation will be installed and tested [WAC 173-303-640(3)(c) through (e), WAC 173-303-640(4)(b) and (c), WAC 173-303-806(4)(c)(vi), and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.d.xi. Mass and energy balance for projected normal operating conditions used in developing the Piping and Instrumentation Diagrams and Process Flow Diagrams, including assumptions and formulas used to complete the mass and energy balance, so that they can be independently verified, for incorporation into the Administrative Record [WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.d.xii. Documentation that sub-systems equipment are designed to prevent the accumulation of hydrogen gas levels above the lower explosive limit into the Administrative Record [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A), and WAC 173-303-806(4)(i)(v)] [WAC 173-303-815(2)(b)(ii)];

III.10.J.5.d.xiii. Leak Detection system documentation (e.g. vendor information etc.) consistent with information submitted under Permit Condition III.10.J.5.c.ii. and Permit Conditions III.10.J.5.d.ii., vii., viii., and x. above, ~~shall~~ will be submitted for incorporation into the Administrative Record.

III.10.J.5.e. Prior to initial receipt of dangerous and/or mixed waste in the WTP Unit, the Permittees ~~shall~~ will submit to Ecology, pursuant to Permit Condition III.10.C.9.f., the following as specified below for incorporation into Operating Unit 10, Appendix 10.18 of this Permit, except Permit Condition III.10.J.5.e.i., which will be incorporated into Operating Unit 10, Chapter 6.0 of this Permit. All information provided under this permit condition must be consistent with information provided pursuant to Permit Conditions III.10.J.5.b., c., d., e., and f., III.10.C.3.e.v., and III.10.C.11.b., as approved by Ecology:

III.10.J.5.e.i. Integrity assessment program and schedule for the HLW Vitrification System ~~shall~~ will address the conducting of periodic integrity assessments on the HLW Vitrification System over the life of the system, as specified in Permit Condition III.10.J.5.b.ix. and as specified in WAC 173-303-640(3)(b), in accordance with WAC 173-303-680, and descriptions of procedures for addressing problems detected during integrity assessments. The schedule must be based on past integrity assessments, age of the system, materials of construction, characteristics of the waste, and any other relevant factors [WAC 173-303-640(3)(b), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.e.ii. Detailed plans and descriptions, demonstrating the leak detection system is operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of dangerous and/or mixed waste or accumulated liquid in the secondary containment system within twenty-four (24) hours [WAC 173-303-640(4)(c)(iii)]. Detection of a leak of at least 0.1 gallons per hour within twenty-four (24) hours is defined as being able to detect a leak within twenty-four (24) hours. Any exceptions to this criteria must be approved by Ecology in accordance with WAC 173-303-680, WAC 173-303-640(4)(c)(iii), and WAC 173-303-806(4)(i)(i)(b);

III.10.J.5.e.iii. Detailed operational plans and descriptions, demonstrating that spilled or leaked waste and accumulated precipitation liquids can be removed from the secondary containment system within twenty-four (24) hours [WAC 173-303-806(4)(i)(i)(B)];

III.10.J.5.e.iv. Descriptions of operational procedures demonstrating appropriate controls and practices are in place to prevent spills and overflows from the HLW Vitrification System or containment systems in compliance with WAC 173-303-640(5)(b)(i) through (iii), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B);

III.10.J.5.e.v. Description of procedures for investigation and repair of the HLW Vitrification System [WAC 173-303–640(6) and WAC 173-303-640(7)(e) and (f), in accordance with WAC 173-303-680, WAC 173-303-320, WAC 173-303-806(4)(ia)(iv), and WAC 173-303-806(4)(a)(ii)(B)];

III.10.J.5.e.vi. Updated Chapter 4.0, Narrative Description, Tables and Figures as identified in Permit Tables III.10.J.A and III.10.J.B, as modified pursuant to Permit Condition III.10.H.5.e.x. and updated to identify routinely non-accessible LAW Vitrification sub-systems.

III.10.J.5.e.vii. Description of procedures for management of ignitable and reactive, and incompatible dangerous and/or mixed waste as specified in accordance with WAC 173-303-640(9) and (10), in accordance with WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(B).

III.10.J.5.e.viii. A description of the tracking system used to track dangerous and/or mixed waste generated throughout the HLW Vitrification System, pursuant to WAC 173-303-380.

III.10.J.5.e.ix. Permit Table III.10.J.C and III.10.K.C ~~shall~~ will be revised and/or completed for HLW Vitrification System process and leak detection system monitors and instruments (to include, but not be limited to: instruments and monitors measuring and/or controlling flow, pressure, temperature, density, pH, level, humidity, and emissions) to provide the information as specified in each column heading. Process and leak detection system monitors and instruments for critical systems, as specified in Operating Unit 10, Appendix 2.0 and as updated pursuant to Permit Condition III.10.C.9.b and for operating parameters as required to comply with Permit Condition III.10.C.3.e.iii., ~~shall~~ will be addressed. Process monitors and instruments for non-waste management operations (e.g., utilities, raw chemical storage, non-contact cooling waters, etc.) are excluded from this permit condition [WAC 173-303-680, WAC 173-303-806(4)(i)(i)(A) through (B), and WAC 173-303-806(4)(i)(v)];

III.10.J.5.e.x. Permit Tables III.10.J.A and III.10.K.A amended as follows [WAC 173-303-680 and WAC 173-303-806(4)(i)(i)(A) through (B)]:

A. Under column 1, update and complete list of dangerous and mixed waste HLW Vitrification System sub-systems, including plant items that comprise each system (listed by item number).

B. Under column 2, update and complete system designations.

C. Under column 3, replace the 'Reserved' with Operating Unit 10, Appendix 10.0 sub-sections (e.g., 10.1, 10.2, etc.) designated in Permit Conditions III.10.J.5.b., c., and d. specific to HLW Vitrification System sub-system, as listed in column 1.

D. Under column 4, update and complete list of narrative description, tables, and figures.

III.10.J.5.f. One hundred and eighty (180) days prior to initial receipt of dangerous and/or mixed waste in the WTP Unit, the Permittees ~~shall~~ will submit for review and receive approval for incorporation into Operating Unit 10, Appendix 10.15 of this Permit, a Demonstration Test Plan for the HLW Vitrification System to demonstrate that the HLW Vitrification Systems meets the performance standards specified in Permit Condition III.10.J.1.b. In order to incorporate the Demonstration Test Plan for the HLW Vitrification System into Operating Unit 10, Appendix 10.15, Permit Condition III.10.C.2.g. process will be followed. The Demonstration Test Plan ~~shall~~ will include, but not be limited to, the following information. The Demonstration Test Plan ~~shall~~ will also be consistent with the information provided pursuant to Permit Conditions III.10.J.5.b., c., d. and e., III.10.C.3.e.v. and III.10.C.11.b., as approved by Ecology and consistent with the schedule described in Operating Unit 10, Appendix 1.0 of this Permit. The documentation required pursuant to Permit Condition III.10.J.5.f.xvi., in addition to being incorporated into Operating Unit 10, Appendix 10.15, ~~shall~~ will be incorporated by

III.10.J HLW Vitrification System – Short Term Miscellaneous Thermal Treatment Unit-Shakedown, Demonstration Test, and Post Demonstration Test

For purposes of Permit Section III.10.J, where reference is made to WAC 173-303-640, the following substitutions apply: substituting the terms "HLW Vitrification System" for "tank system(s)," "sub-system(s)" for "tank(s)," "sub-system equipment" for "ancillary equipment," and "sub-system(s) or sub-system equipment of a HLW Vitrification System" for "component(s)," in accordance with WAC 173-303-680.

III.10.J.1. III.10.I.1.h.General Conditions During Shakedown, Demonstration Test, and Post-Demonstration Test for HLW Vitrification System

III.10.J.1.a. Construction and Maintenance [WAC 173-303-640, in accordance with WAC 173-303-680(2) and (3), and WAC 173-303-340]

III.10.J.1.a.i. The Permittees ~~shall~~ will construct the HLW Vitrification System (listed in Permit Tables III.10.J.A and III.10.J.B, as approved/modified pursuant to Permit Condition III.10.J.5.) as specified in Permit Condition III.10.J.1. and Operating Unit 10, Chapter 4.0 of this Permit, and Operating Unit 10, Appendices 10.1 through 10.15 and 10.17 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.a. through d., and III.10.J.5.f.

III.10.J.1.a.ii. The Permittees ~~shall~~ will construct all containment systems for the HLW Vitrification System as specified in Operating Unit 10, Chapter 4.0 of this Permit, and Operating Unit 10, Appendices 10.2, 10.4, through 10.14 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.a. through d.

III.10.J.1.a.iii. The Permittees ~~shall~~ will ensure all certifications required by specialists (e.g., independent, qualified, registered professional engineer, independent corrosion expert, independent qualified installation inspector, etc.) use the following statement or

III.10.J.5.f.iv. A description of how the surrogate feeds are to be introduced for the demonstration. This description should clearly identify the differences and justify how any of differences would impact the surrogate feed introduction as representative of how mixed waste feeds will be introduced;

III.10.J.5.f.v. A detailed engineering description of the HLW Vitrification System, including:

A. Manufacturer's name and model number for each sub-system;

B. Design capacity of each sub-system including documentation (engineering calculations, manufacturer/vendor specifications, operating data, etc.) supporting projected operational efficiencies (e.g., WESP projected removal efficiency for individual metals, halogens, particulates, etc.) and compliance with performance standards specified in Permit Condition III.10.J.1.b.;

C. Detailed scaled engineering drawings, including Process Flow Diagrams, Piping and Instrumentation Diagrams, Vessel Drawings (plan, and elevation with cross sections) and General Arrangement Drawings;

D. Process Engineering Descriptions;

E. Mass and energy balances for each projected operating condition and each demonstration test condition, including assumptions and formulas used to complete mass and energy balances so that they can be independently verified for incorporation into the Administrative Record;

F. Engineering Specifications/data sheets (materials of construction, physical and chemical tolerances of equipment, equipment performance warranties, and fan curves);

G. Detailed Description of Automatic Waste Feed Cut-off System addressing critical operating parameters for all performance standards specified in Permit Condition III.10.J.1.b.

H. Documentation to support compliance with performance standards specified in Permit Condition III.10.J.1.b., including engineering calculations, test data, and manufacturer/vendor's warranties, etc.

I. Detailed description of the design, operation and maintenance practices for air pollution control system.

J. Detailed description of the design, operation, and maintenance practices of any stack gas monitoring and pollution control monitoring system.

K. Documentation based on current WTP Unit design either confirming the Permittees' demonstration that it is not technically appropriate to correct standards listed in Permit Conditions III.J.1.b.ii. through III.J.1.b.ix. to seven percent (7%) oxygen,. or a request, pursuant to Permit Conditions III.10.C.9.e. and III.10.C.9.f., to update Permit Conditions III.J.1.b.ii. through III.J.1.b.ix., III.K.b.ii. through III.K.b.ix., III.K.e.iii., and III.J.1.e.iii., Permit Tables III.10.J.C, III.10.J.F, III.10.K.C., III.10.K.F and

Operating Unit 10, Appendix 10.0 to reflect the addition of an oxygen monitor and the correction of the standards to seven percent (7%) oxygen.

III.10.J.5.f.vi. Detailed description of sampling and monitoring procedures including sampling and monitoring locations in the system, the equipment to be used, sampling and monitoring frequency, and planned analytical procedures for sample analysis including, but not limited to:

A. A short summary narrative description of each stack sample method should be included within the main body of the demonstration test plan, which references an appendix to the plan that would include for each sampling train: (1) detailed sample method procedures, (2) sampling train configuration schematic, (3) sampling recovery flow sheet, (4) detailed analytical method procedures, and (5) sampling preparation and analysis flow sheet. The detailed procedures should clearly flag where the method has provided decision points (e.g., choices of equipment materials of construction, choices of clean-up procedures or whether additional clean-up procedures will be incorporated, whether pretest surveys or laboratory validation work will be performed, enhancements to train to accommodate high moisture content in stack gas, etc.) and what is being proposed along with the basis for the decision.

B. A short summary narrative description of the feed and residue sampling methods should be included within the main body of the demonstration test plan, which references an appendix that would include for each sample type: (1) detailed sample method procedures, (2) sampling recovery/compositing procedures, and (3) detailed analytical method procedures. The detailed procedures should clearly flag where the method has provided decision points (e.g., choices of equipment materials of construction, choices of clean-up procedures or whether additional clean-up procedures will be incorporated, whether pretest surveys or laboratory validation work will be performed, etc.) and what is being proposed along with the basis for the decision.

III.10.J.5.f.vii. A detailed test schedule for each condition for which the demonstration test is planned, including projected date(s), duration, quantity of dangerous waste to be fed, and other relevant factors;

III.10.J.5.f.viii. A detailed test protocol including, for each test condition, the ranges of feed-rate for each feed system, and all other relevant parameters that may affect the ability of the HLW Vitrification System to meet performance standards specified in Permit Condition III.10.J.1.b.;

III.10.J.5.f.ix. A detailed description of planned operating conditions for each demonstration test condition, including operating conditions for shakedown, demonstration test, post-demonstration test and normal operations. This information ~~shall~~ will also include submittal of Permit Tables III.10.J.D, III.10.J.F, III.10.K.D, and III.10.K.F completed with the information as specified in each column heading for each HLW Vitrification System waste feed cut-off parameter and submittal of supporting documentation for Permit Tables III.10.J.D, III.10.J.F, III.10.K.D, and III.10.K.F set-point values.

III.10.J.5.f.x. The test conditions proposed must demonstrate meeting the performance standards specified in Permit Condition III.10.J.1.b. with the simultaneous operation of the melter at capacity and input from the HLW Vitrification Vessel Ventilation System at capacity to simulate maximum loading to the HLW Vitrification System off-gas treatment system and to establish the corresponding operating parameter ranges.

III.10.J.5.f.xi. A detailed description of procedures for start-up and shutdown of waste feed and controlling emissions in the event of an equipment malfunction, including off-normal and emergency shutdown procedures;

III.10.J.5.f.xii. A calculation of waste residence time;

III.10.J.5.f.xiii. Any request to extrapolate metal feed-rate limits from Demonstration Test levels must include:

A. A description of the extrapolation methodology and rationale for how the approach ensures compliance with the performance standards, as specified in Permit Condition III.10.J.1.b.

B. Documentation of the historical range of normal metal feed-rates for each feedstream.

C. Documentation that the level of spiking recommended during the demonstration test will mask sampling and analysis imprecision and inaccuracy to the extent that extrapolation of feed-rates and emission rates from the Demonstration Test data will be as accurate and precise as if full spiking were used.

III.10.J.5.f.xiv. Documentation of the expected levels of constituents in HLW Vitrification System input streams, including, but not limited to, waste feed, glass former and reactants, control air, process air, steam, sparge bubbler air, air in-leakage from melter cave, gases from HLW Vitrification Vessel Ventilation System, and process water.

III.10.J.5.f.xv. Documentation justifying the duration of the conditioning required to ensure the HLW Vitrification System had achieved steady-state operations under Demonstration Test operating conditions.

III.10.J.5.f.xvi. Documentation of HLW Vitrification System process and leak detection system instruments and monitors as listed on Permit Tables III.10.J.C, III.10.J.F, III.10.K.C, and III.10.K.F to include:

A. Procurement specifications

B. Location used

C. Range, precision, and accuracy

D. Calibration/functionality test procedures (either method number ASTM) or provide a copy of manufacturer's recommended calibration procedures

E. Calibration/functionality test, inspection, and routine maintenance schedules and checklists, including justification for calibration, inspection and maintenance frequencies, criteria for identifying instruments found to be significantly out of calibration, and corrective action to be taken for instruments found to be significantly out of calibration (e.g., increasing frequency of calibration, instrument replacement, etc.).

F. Equipment instrument control logic narrative description (e.g., software functional specifications, descriptions of fail safe conditions, etc.) [WAC 173-303-680(2), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-806(4)(i)(v)]

III.10.J.5.f.xvii. Outline of demonstration test report.

Table III.10.J.A - HLW Vitrification System Description

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
HLW Concentrate Receipt Process System & HLW Melter Feed Process System (Comprised of the following: Feed Preparation Vessels -HFP-VSL-00001/5[a];	HFP HCP	**24590-HLW** -3YD-HFP-00001 -M5-V17T-P0001 -M6-HFP-P0001 -M6-HFP-P0002 -M6-HFP-P20001 -M6-HFP-P20002 -PER-J-04-0001	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter Feed Vessel -HFP-VSL-00002/6[a] (HLW Melter Feed Process System)	HFP	**24590-HLW** -3YD-HFP-00001 -M5-V17T-P0001 -M6-HFP-P0002 -M6-HFP-P20002 -PER-J-04-0001	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter Process System (Comprised of the following: HLW Melter 1/2 -HMP-MLTR-00001/2)	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27, 4A-54; Table 4-14
HLW Glass Product System-Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
Melter Offgas Treatment Process System (Comprised of the following: Offgas Film Cooler - Melter 1/2 -HOP-FCLR-00001/2)	HOP	RESERVED **24590-HLW** -3YD-HOP-00001 -M5-V17T-P0002 -M5-V17T-P20002 -M6-HMP-P0002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27; Table 4-14

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		-M6-HMP-P20002	
Melter Offgas Treatment Process System (Comprised of the following: HLW Submerged Bed Scrubbers -/Condensate Collection Vessels –HOP-SCB-00001/2 – Melters 1 & 2)	HOP	24590-HLW -3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0001 -M6-HOP-P20001 -MKD-HOP-P0016 -MK-HOP-P0001001 -MK-HOP-P0001002 -MK-HOP-P0001003 -MK-HOP-P0001004 -MVD-HOP-P0015 -MVD-HOP-P0016 -N1D-HOP-P0010 -P1-P01T-P0002 24590-WTP -3PS-MV00-TP001 -3PS-MV00-TP002 -3PS-MV00-TP003	Section 4.1.4.3; Table 4-5 & Table 4-14, Figures 4A-1, 4A-4, 4A-28
SBS Condensate Receiver Vessels (HOP-VSL-00903[a], HOP-VSL-000904[a]	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0004 -M6-HOP-P0006 -M6-HOP-P0008 -M6-HOP-P20003 -M6-HOP-P20008 -MVD-HOP-P0001	Section 4.1.4.3; Table 4-5 &, Figures 4A-1, 4A-4, 4A-28

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		~~-MV-HOP-P0001~~ ~~-MV-HOP-P0003~~ ~~-N1D-HOP-P0006~~	
Melter Offgas Treatment Process System (Comprised of the following: Wet Electrostatic Precipitator-Melter 1&2 HOP-WESP-00001 HOP-WESP-00002)	HOP	24590-HLW -3YD-HOP-00001 ~~-HOP-WESP-00001~~ ~~-HOP-WESP-00002~~ -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0002 -M6-HOP-P20002 -N1D-HOP-P0002 -P1-P01T-P0004 -P1-P01T-P0005 24590-WTP-3PS-MKE0-TP001	Section 4.1.4.3; Figures 4A-1, ~~4A-4, 4A-28~~; Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Particulate Air (HEPA) Filters -Melters 1 & 2 -HOP-HEPA-00001A/1B -HOP-HEPA-00002A/2B ~~-HOP-HEPA-00012A/B~~ -HOP-HEPA-00007A/7B -HOP-HEPA-00008A/8B ~~-HOP-HEPA-00013A/B)~~	HOP	24590-HLW -3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0010 -M6-HOP-P20010 -MAD-HOP-P0010 -MAD-HOP-P0011 -MAD-HOP-P0012 -MAD-HOP-P0013 -MAD-HOP-P0014 -MAD-HOP-P0015 -MAD-HOP-P0016	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-29~~; Table 4-14

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		-MAD-HOP-P0017 -P1-P01T-P0002 24590-WTP-3PS-MKH0-TP002	
Melter Offgas Treatment Process System (Comprised of the following: Activated Carbon Adsorber HOP-ADBR-00001A/1B/2A/2B)	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MVD-HOP-P0015 -MVD-HOP-P0016 -N1D-HOP-P0003 -P1-P01T-P0002 24590-WTP-3PS-MWK0-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-29;~~ Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Mist Eliminators - Melters 1/2 (HOP-HEME-00001A/1B/2A/2B)	HOP	**24590-HLW** 3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 ~~-M6-HOP-P0002~~ -M6-HOP-P0009 -M6-HOP-P20009 ~~-MKD-HOP-P0007~~ -MVD-HOP-P0007 ~~-MVD-HOP-P0015~~ ~~-MVD-HOP-P0016~~ -MV-HOP-P0002001 -MV-HOP-P0002002 -MV-HOP-P0002003	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-28;~~ Table 4-14

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		-N1D-HOP-P0001 -P1-P01T-P0002	
Melter Offgas Treatment Process System (Comprised of the following: Thermal Catalytical Oxidation Unit-HOP-SCO-00001/4) [located on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003])	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -N1D-HOP-P0004 -NID-HOP-P0005 -P1-PO1T-P0002 24590-WTP-3PS-MBTV-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-29;~~ Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: NOx Selective Catalytical Reduction Unit-HOP-SCR-00001/2 [located on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003])	HOP	~~RESERVED~~ 24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -N1D-HOP-P0004 -N1D-HOP-P0005 -P1-PO1T-P0002 24590-WTP-3PS-MBTV-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-29;~~ Table 4-14
Catalyst Skid Preheaters (HOP-HX-00001, HOP-HX-00003), on Catalyst Skids HOP-	HOP	24590-HLW -M5-V17T-P0004	Section 4.1.4.3.2; Table 4-14; Figures 4A-1, 4A-4, 4A-29

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
SCO-00002 and HOP-SCO-00003		-M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -P1-PO1T-P0002 24590-WTP-3PS-MBTV-TP001	
Catalyst Skid Electric Heaters (HOP-HTR-00001, HOP-HTR-00007), on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -P1-PO1T-P0002 24590-WTP-3PS-MBTV-TP001	Section 4.1.4.3.2; Table 4-14; Figures 4A-1, 4A-4, 4A-29
Melter Offgas Treatment Process System (Comprised of the following: ~~Melter 1~~ Silver Mordenite Column (HOP-ABS-00002), ~~Melter 2~~ Silver Mordenite Column (HOP-ABS-00003)	HOP	24590-HLW -3PS-MBT0-TP001 -M5-V17T-P0004 -M5-V17T-P20004 ~~-M6-HOP-P0003~~ -M6-HOP-P0008 ~~-M6-HOP-P20003~~ -M6-HOP-P20008 -MKD-HOP-P0014 -MKD-HOP-P0017 -NID-HOP-P0006	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-29~~; Table 4-14

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		-P1-P01T-P0001	
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Particulate Air (HEPA) Preheaters Electric Heaters-HOP-HTR-00002A/1B, HOP-HTR-00005A/5B	HOP	**24590-HLW** -3PS-MEE0-TP001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0010 -M6-HOP-P20010 -MED-HOP-P0013	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29; Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: Heat Exchangers-ME-Silver Mordenite Preheaters HOP-HX-00002/4)	HOP	**24590-HLW** M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MED-HOP-P0012 -MED-HOP-P0017 -N1D-HOP-P0007 -P1-P01T-P0002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29; Table 4-14
Pumps-HFP-EDUC-00001/2/3/4	HFP/HOP	**24590-HLW** -M6-HFP-P0001 -M6-HFP-P0002 -M6-HFP-P20001 -M6-HFP-P20002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27, 4A-28, 4A-29
Melter Offgas Treatment Process System (Comprised of the following: Booster Extraction Fans-MA-HOP-FAN-00001A/1B/1C, MA-HOP-FAN-00009A/9B/9C]	HOP	**24590-HLW** M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MAD-HOP-P0020 -MAD-HOP-P0018	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29; Table 4-14

Sub-system Description	Sub-system Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
		-MAD-HOP-P0019 -MAD-HOP-P0035 -MAD-HOP-P0036 -MAD-HOP-P0037 -P1-P01T-P0001 24590-WTP-3PS-MACS-TP004	
Stack Extraction Fans-HOP-FAN-00008A/B/C & HOP-FAN-000010A/B/C	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MAD-HOP-P0038 -P1-P01T-P0005 24590-WTP-3PS-MACS-TP004	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29 Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: HLW Stack)	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
	PJV (HLW Pulse Jet Ventilation Treatment System)	24590-HLW -M5-V17T-P0005 -M6-PJV-POOO1	

Sub-system Description	**Sub-system Designation**	**Engineering Description (Drawing Nos., Specification Nos., etc.)**	**Narrative Description, Tables, and Figures**
~~High-Efficiency Particulate Air (HEPA)Filters Primary (PJV-HEPA-00004A)~~ ~~High-Efficiency Particulate Air Filters—Standby Primary (PJV-HEPA-00004B)~~ ~~High-Efficiency Particulate Air Filters—Secondary (PJV-HEPA-00005A)~~ ~~High-Efficiency Particulate Air Filters—Standby Secondary (PJV-HEPA-00005B))~~	~~PJV (HLW Pulse Jet Ventilation Treatment System)~~	~~24590-HLW -M5-V17T-P0005 -M6-PJV-P0002~~	
~~Booster Fans (PJV-FAN-00002A/B))~~	~~PJV (HLW Pulse Jet Ventilation Treatment System)~~	~~24590-HLW -3YD-PJV-00001 -M5-V17T-P0005 -M6-PJV-P0002 -P1-P01T-P0005 24590-WTP-3PS-MACS-TP004~~	~~RESERVED~~

a. Requirements pertaining to the tanks in ~~HLW Vitrification System-Melter Feed System &~~ SBS Condensate Receiver Vessels are specified in Permit Section III.10.E.

Table III.10.J.B. - HLW Vitrification Systems Secondary Containment Systems Including Sumps and Floor Drains

Sump/Floor Drain I.D.# & Room Location	Maximum Sump Capacity (gallons)	Sump Dimensions (feet) & Materials of Construction	Maximum Allowable Liquid Height (inches)	Secondary Containment Volume (gallons)	Engineering Description (Drawing Nos., Specification Nos., etc.)
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED

Table III.10.J.C. - .HLW Vitrification System Process and Leak Detection System Instruments and Parameters

P&ID	Monitoring or Control Parameter	Type of Instrument or Control Device	Instrument or Control Device Tag No.	Instrument Range	Expected Range	Fail States	Instrument Accuracy	Instrument Calibration Method No. and Range
24590-HLW-M6-HMP-P0013	Melter 1 shell leak detection	TBD	LT-0144, LI-0144	TBD	TBD	TBD	TBD	TBD

24590-HLW-M6-HMP-P2013	Melter 2 shell leak detection	TBD	LT-2144, LI-2144	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0003	Melter 1 refractory temperature, East wall, 45"	TBD	TE-0337, TT-0037, TI-0337	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0003	Melter 1 refractory temperature, East wall, 33"	TBD	TE-0338, TI-0338	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0003	Melter 1 refractory temperature, East wall, 21"	TBD	TE-0339, TI-0339	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0003	Melter 1 refractory temperature, East wall, 9"	TBD	TE-0340, TI-0340	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0003	Melter 1 refractory temperature, East wall, -3"	TBD	TE-0341, TI-0341	TBD	TBD	TBD	TBD	TBD
24590-HLW-	Melter 1	TBD	TE-0342,	TBD	TBD	TBD	TBD	TBD

M6-HMP-P0014	refractory temperature, West wall, 45"		TT-0342, TI-0342					
24590-HLW-M6-HMP-P0014	Melter 1 refractory temperature, West wall, 33"	TBD	TE-0343, TI-0343	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0014	Melter 1 refractory temperature, West wall, 21"	TBD	TE-0344, TI-0344	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0014	Melter 1 refractory temperature, West wall, 9"	TBD	TE-0345, TI-0345	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0014	Melter 1 refractory temperature, West wall, -3"	TBD	TE-0346, TI-0346	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2003	Melter 2 refractory temperature, East wall,	TBD	TE-2337, TT-2337, TI-2337	TBD	TBD	TBD	TBD	TBD

	45"							
24590-HLW-M6-HMP-P2003	Melter 2 refractory temperature, East wall, 33"	TBD	TE-2338, TI-2338	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2003	Melter 2 refractory temperature, East wall, 21"	TBD	TE-2339, TI-2339	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2003	Melter 2 refractory temperature, East wall, 9"	TBD	TE-2340, TI-2340	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2003	Melter 2 refractory temperature, East wall, -3"	TBD	TE-2341, TI-2341	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2014	Melter 2 refractory temperature, West wall, 45"	TBD	TE-2342, TT-2342, TI-2342	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2014	Melter 2 refractory temperature,	TBD	TE-2343, TI-2343	TBD	TBD	TBD	TBD	TBD

	West wall, 33"							
24590-HLW-M6-HMP-P2014	Melter 2 refractory temperature, West wall, 21"	TBD	TE-2344, TI-2344	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2014	Melter 2 refractory temperature, West wall, 9"	TBD	TE-2345, TI-2345	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2014	Melter 2 refractory temperature, West wall, -3"	TBD	TE-2346, TI-2346	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0004	Melter 1 plenum temperature, 62"	TBD	TE-0920A, TT-0920A, TI-0920A	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0004	Melter 1 plenum temperature, 59"	TBD	TE-0920B, TI-0920B	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0004	Melter 1 plenum temperature,	TBD	TE-0920C, TT-0921A, TI-0920C	TBD	TBD	TBD	TBD	TBD

	62"							
24590-HLW-M6-HMP-P0004	Melter 1 plenum temperature, 59"	TBD	TE-920D, TI-0920D	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2004	Melter 2 plenum temperature, 62"	TBD	TE-2920A, TT-2920A, TI-2920A	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2004	Melter 2 plenum temperature, 59"	TBD	TE-2920B, TI-2920B	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2004	Melter 2 plenum temperature, 62"	TBD	TE-2920C, TI-2920C	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2004	Melter 2 plenum temperature, 59"	TBD	TE-2920D, TI-2920D	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0004	Melter 1 plenum average temperature	TBD	TY-0920, TI-0920	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-	Melter 2 plenum	TBD	TY-2920, TI-	TBD	TBD	TBD	TBD	TBD

P2004	average temperature		2920					
24590-HLW-M6-HMP-P0013	Melter 1 glass pool density	TBD	DT-0132, DI-0132	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0013	Melter 1 glass pool level	TBD	LT-0131, LI-0131	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2013	Melter 2 glass pool density	TBD	DT-2132, DI-2132	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2013	Melter 2 glass pool level	TBD	LT-2131, LI-2131	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P0013	Melter 1 plenum pressure	TBD	PDT-0139A, PDT-0139B, PDI-0139A, PDI-0139B, PDY-0139A	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2013	Melter 2 plenum pressure	TBD	PDT-2139A, PDT-2139B, PDI-2139A, PDI-2139B, PDY-2139A	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-	Melter 1 West canister	TBD	LT-0816, LI-0816A, LI-	TBD	TBD	TBD	TBD	TBD

P0008	level		0816B					
24590-HLW-M6-HMP-P0008	Melter 1 East canister level	TBD	LT-0820, LI-0820A, LI-0820B	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2008	Melter 2 West canister level	TBD	LT-2816, LI-2816A, LI-2816B	TBD	TBD	TBD	TBD	TBD
24590-HLW-M6-HMP-P2008	Melter 2 East canister level	TBD	LT-2820, LI-2820A, LI-2820B	TBD	TBD	TBD	TBD	TBD
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED

Table III.10.J.D. – Maximum Feed-rates to HLW Vitrification System (RESERVED)

Description of Waste	Shakedown 1 and Post Demonstration Test	Shakedown 2 and Demonstration Test
Dangerous and Mixed Waste Feed Rate		
Ash Feed Rate		
Total Chlorine/Chloride Feed Rate		
Total Metal Feedrates		

Table III.10.J.E. - HLW Vitrification System Estimated Emission Rates (RESERVED)

Chemicals	CAS Number	Emission Rates (grams /second)

Table III.10.J.F. - HLW Vitrification System Waste Feed Cut-off Parameters* (RESERVED)

Subsystem Designation	Instrument Tag Number	Parameter Description	Setpoints During Shakedown 1 and Post Demonstration Test	Setpoints During Shakedown 2 and Demonstration Test

*A continuous monitoring system ~~shall~~ will be used as defined in Permit Section III.10.C.1.

[1]Maximum Feed-rate ~~shall~~ will be set based on not exceeding any of the constituent (e.g., metals, ash, and chlorine/chloride) feed limits specified on Table III.10.J.D. of this Permit

III.10.K HLW Vitrification System – Long Term Miscellaneous Thermal Treatment Unit

For purposes of Permit Section III.10.K, where reference is made to WAC 173-303-640, the following substitutions apply: substitute the terms "HLW Vitrification System" for "tank system(s)," "sub-system(s)" for "tank(s)," "sub-system equipment" for "ancillary equipment," and "sub-system(s) or sub-system equipment of a HLW Vitrification System" for "component(s)," in accordance with WAC 173-303-680.

III.10.K.1 Requirements For HLW Vitrification System Beginning Normal Operation

Prior to commencing normal operations provided in Permit Section III.10.K, all requirements in Permit Section III.10.J ~~shall~~ will have been met by the Permittees and approved by Ecology, including the following: The HLW Vitrification System Demonstration Test results and the revised Final Risk Assessment provided for in Permit Conditions III.10.C.11.c. or d. and Permit Section III.10.J, ~~shall~~ will have been evaluated and approved by Ecology, Permit Tables III.10.K.D and F, as approved/modified pursuant to Permit Condition III.10.J.5, ~~shall~~ will have been completed, submitted and approved pursuant to Permit Condition III.10.J.3.d.v. and Permit Table III.10.K.E, as approved/modified pursuant to Permit Condition III.10.J.5, ~~shall~~ will have been completed, submitted and approved pursuant to Permit Conditions III.10.C.11.c. or d.

III.10.K.1.a. Construction and Maintenance [WAC 173-303-640, in accordance with WAC 173-303-680(2) and (3), and WAC 173-303-340]

III.10.K.1.a.i. The Permittees ~~shall~~ will maintain the design and construction of the HLW Vitrification System as specified in Permit Condition III.10.K.1, Operating Unit 10, Chapter 4.0 of this Permit, and Operating Unit 10, Appendices 10.1 through 10.17 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.a. through d. and III.10.J.5.f.

III.10.K.1.a.ii. The Permittees ~~shall~~ will maintain the design and construction of all containment systems for the HLW Vitrification System as specified in Operating Unit 10, Chapter 4.0 of this Permit, and Operating Unit 10, Appendices 10.2 and 10.4 through 10.14 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.a. through d.

III.10.K.1.a.iii. Modifications to approved design, plans, and specifications in Operating Unit 10, of this Permit, for the HLW Vitrification System ~~shall~~ will be allowed only in accordance with Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g., III.10.C.9.d., e., and h.

III.10.K.1.a.iv. The Permittees ~~shall~~ will ensure all certifications required by specialists (e.g., independent, qualified, registered professional engineer; registered, professional engineer; independent corrosion expert; independent, qualified installation inspector; installation inspector; etc.) use the following statement or equivalent pursuant to Permit Condition III.10.C.10:

"I, (Insert Name) have (choose one or more of the following: overseen, supervised, reviewed, and/or certified) a portion of the design or installation of a new HLW Vitrification system or component located at (address), and owned/operated by (name(s)). My duties were: (e.g., installation inspector, testing for tightness, etc.), for the following

HLW Vitrification system components (e.g., the venting piping, etc.), as required by the Dangerous Waste Regulations, namely, WAC 173-303-640(3) (applicable paragraphs [i.e., (a) through (g)]), in accordance with WAC 173-303-680.

"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."

III.10.K.1.a.v. The Permittees ~~shall~~ will ensure periodic integrity assessments are conducted on the HLW Vitrification System listed in Permit Table III.10.I.A, as approved/modified pursuant to Permit Condition III.10.J.5, over the term of this Permit, in accordance with WAC 173-303-680(2) and (3), as specified in WAC 173-303-640(3)(b) following the description of the integrity assessment program and schedule in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c. Results of the integrity assessments ~~shall~~ will be included in the WTP Unit operating record until ten (10) years after post-closure, or corrective action is complete and certified, whichever is later.

III.10.K.1.a.vi. The Permittees ~~shall~~ will address problems detected during the HLW Vitrification System integrity assessments specified in Permit Condition III.10.K.1.a.v. following the description of the integrity assessment program in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c.

III.10.K.1.a.vii. All process monitors/instruments as specified in Permit Table III.10.K.F, as approved/modified pursuant to Permit Condition III.10.J.5 and III.10.J.3.d.v., ~~shall~~ will be equipped with operational alarms to warn of deviation, or imminent deviation from the limits specified in Permit Table III.10.K.F.

III.10.K.1.a.viii. The Permittees ~~shall~~ will install and test all process and leak detection system monitors/instruments, as specified in Permit Tables III.10.K.C and III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.10.J.3.d.v., in accordance with Operating Unit 10, Appendices 10.1, 10.2, and 10.14 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.d.x. and III.10.J.5.f.xvi.

III.10.K.1.a.ix. No dangerous and/or mixed waste ~~shall~~ will be treated in the HLW Vitrification System unless the operating conditions, specified under Permit Condition III.10.K.1.c. are complied with.

III.10.K.1.a.x. The Permittees ~~shall~~ will not place dangerous and/or mixed waste, treatment reagents, or other materials in the HLW Vitrification System if these substances could cause the sub-system, sub-system equipment, or the containment system to rupture, leak, corrode, or otherwise fail [WAC 173-303-640(5)(a), in accordance with WAC 173-303-680(2)]. This condition is not applicable to corrosion of HLW Vitrification System sub-system or sub-system equipment that are expected to be replaced as part of normal operations (e.g., melter).

III.10.K.1.a.xi. The Permittees ~~shall~~ will operate the HLW Vitrification System to prevent spills and overflows using the description of controls and practices as required under WAC 173-303-640(5)(b), described in Permit Condition III.10.C.5, and Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e. [WAC 173-303-640(5)(b), in accordance with WAC 173-303-680(2) and (3), WAC-173-303-806(4)(c)(ix)].

III.10.K.1.a.xii. For routinely non-accessible HLW Vitrification System sub-systems, as specified in Operating Unit 10, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., the Permittees ~~shall~~ will mark all routinely non-accessible HLW Vitrification System sub-systems access points with labels or signs to identify the waste contained in each HLW Vitrification System sub-system. The label, or sign, must be legible at a distance of at least fifty (50) feet, and must bear a legend which identifies the waste in a manner which adequately warns employees, emergency response personnel, and the public of the major risk(s) associated with the waste being stored or treated in the HLW Vitrification System sub-systems. For the purposes of this permit condition, "routinely non-accessible" means personnel are unable to enter these areas while waste is being managed in them [WAC 173-303-640(5)(d), in accordance with WAC 173-303-680(2)].

III.10.K.1.a.xiii. For all the HLW Vitrification System sub-systems not addressed in Permit Condition III.10.K.1.a.xii., the Permittees ~~shall~~ will mark all these HLW Vitrification System sub-systems holding dangerous and/or mixed waste with labels or signs to identify the waste contained in the HLW Vitrification System sub-systems. The labels, or signs, must be legible at a distance of at least fifty (50) feet, and must bear a legend which identifies the waste in a manner which adequately warns employees, emergency response personnel, and the public of the major risk(s) associated with the waste being stored or treated in the HLW Vitrification System sub-systems [WAC 173-303-640(5)(d), in accordance with WAC 173-303-680(2)].

III.10.K.1.a.xiv. The Permittees ~~shall~~ will ensure that the secondary containment systems for the HLW Vitrification System sub-systems listed in Permit Tables III.10.K.A and III.10.K.B, as approved/modified pursuant to Permit Condition III.10.J.5, are free of cracks or gaps to prevent any migration of dangerous and/or mixed waste or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the HLW Vitrification System sub-systems. Any indication that a crack or gap may exist in the containment systems ~~shall~~ will be investigated and repaired in accordance with Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e.v. [WAC 173-303–640(4)(b)(i), WAC 173-303-640(4)(e)(i)(C), and WAC 173-303-640(6), in accordance with WAC 173-303-680(2) and (3), WAC 173-303-806(4)(i)(i)(B), and WAC 173-303-320].

III.10.K.1.a.xv. The Permittees must immediately and safely remove from service any HLW Vitrification System or secondary containment system which through an integrity assessment is found to be "unfit for use" as defined in WAC 173-303-040, following Permit Condition III.10.K.1.a.xvii.A through D, and F. The affected HLW Vitrification System or secondary containment system must be either repaired or closed in accordance with

Permit Condition III.10.K.1.a.xvii.E [WAC 173-303-640(7)(e) and (f) and WAC 173-303-640(8), in accordance with WAC 173-303-680(3)].

III.10.K.1.a.xvi. An impermeable coating, as specified in Operating Unit 10, Appendices 10.4, 10.5, 10.7, 10.9, 10.11, and 10.12 of this Permit, as approved pursuant to Permit Condition III.10.J.5.b.v., ~~shall~~ will be maintained for all concrete containment systems and concrete portions of containment systems for the HLW Vitrification System sub-systems listed in Permit Tables III.10.K.A and III.10.K.B, as approved/modified pursuant to Permit Condition III.10.J.5 (concrete containment systems that do not have a liner, pursuant to WAC 173-303-640(4)(e)(i), in accordance with WAC 173-303-680(2), and have construction joints, ~~shall~~ will meet the requirements of WAC 173-303-640(4)(e)(ii)(C), in accordance with WAC 173-303-680(2). The coating ~~shall~~ will prevent migration of any dangerous and/or mixed waste into the concrete. All coatings ~~shall~~ will meet the following performance standards:

A. The coating must seal the containment surface such that no cracks, seams, or other avenues through which liquid could migrate are present;

B. The coating must be of adequate thickness and strength to withstand the normal operation of equipment and personnel within the given area such that degradation or physical damage to the coating or lining can be identified and remedied before dangerous and/or mixed waste could migrate from the system; and

C. The coating must be compatible with the dangerous and/or mixed waste, treatment reagents, or other materials managed in the containment system [WAC 173-303-640(4)(e)(ii)(D), in accordance with WAC 173-303-680(2) and (3), and WAC 173-303-806(4)(i)(i)(A)].

III.10.K.1.a.xvii. The Permittees ~~shall~~ will inspect all secondary containment systems for the HLW Vitrification System sub-systems listed in Permit Tables III.10.K.A and III.10.K.B, as approved/modified pursuant to Permit Condition III.10.J.5., in accordance with the Inspection Schedule specified in Operating Unit 10, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c., and take the following actions if a leak or spill of dangerous and/or mixed waste is detected in these containment systems [WAC 173-303-640(5)(c), WAC 173-303-640(6) in accordance with WAC 173-303-680(2) and (3), WAC 173-303-320, and WAC 173-303-806(4)(i)(i)(B)]:

A. Immediately, and safely, stop the flow of dangerous and/or mixed waste into the HLW Vitrification System sub-systems or secondary containment system.

B. Determine the source of the dangerous and/or mixed waste.

C. Remove the dangerous and/or mixed waste from the containment area in accordance with WAC 173-303-680(2) and (3), as specified in WAC 173-303-640(7)(b). The dangerous and/or mixed waste removed from containment areas of the HLW Vitrification System ~~shall~~ will be, at a minimum, managed as mixed waste.

D. If the cause of the release was a spill that has not damaged the integrity of the HLW Vitrification System sub-system, the Permittees may return the HLW Vitrification System sub-system to service in accordance with WAC 173-303-680(2) and (3), as specified in WAC 173-303-640(7)(e)(ii). In such case, the Permittees ~~shall~~ will take action to ensure the incident that caused the dangerous and/or mixed waste to enter the containment system will not reoccur.

E. If the source of the dangerous and/or mixed waste is determined to be a leak in from the primary HLW Vitrification System into the secondary containment system, or the system is unfit for use as determined through an integrity assessment or other inspection, the Permittees ~~shall~~ will comply with the requirements of WAC 173-303-640(7) and take the following actions:

1. Close the HLW Vitrification System sub-system following procedures in WAC 173-303-640(7)(e)(i), in accordance with WAC 173-303-680, and Operating Unit 10, Chapter 11.0 of this Permit, as approved pursuant to Permit Condition III.10.C.8; or

2. Repair and re-certify (in accordance with WAC 173-303-810(13)(a), as modified pursuant to Permit Condition III.10.K.1.a.iii.) the HLW Vitrification System, in accordance with Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e.v., before the HLW Vitrification System is placed back into service [WAC 173-303-640(7)(e)(iii) and WAC 173-303-640(7)(f), in accordance with WAC 173-303-680].

F. The Permittees ~~shall~~ will document in the operating record actions/procedures taken to comply with A through E above, as specified in WAC 173-303-640(6)(d), in accordance with WAC 173-303-680(2) and (3).

G. In accordance with WAC 173-303-680(2) and (3), the Permittees ~~shall~~ will notify and report releases to the environment to Ecology as specified in WAC 173-303-640(7)(d).

III.10.K.1.a.xviii. If liquids (e.g., dangerous and/or mixed waste, leaks and spills, precipitation, fire water, liquids from damaged or broken pipes) cannot be removed from the secondary containment system within twenty-four (24) hours, Ecology will be verbally notified within twenty-four (24) hours of discovery. The notification ~~shall~~ will provide the information in A, B, and C, listed below. The Permittees ~~shall~~ will provide Ecology with a written demonstration within seven (7) business days, identifying at a minimum [WAC 173-303-640(4)(c)(iv) and WAC 173-303-640(7)(b)(ii), in accordance with WAC 173-303-680(3) and WAC 173-303-806(4)(i)(i)(B)]:

A. Reasons for delayed removal;

B. Measures implemented to ensure continued protection of human health and the environment;

C. Current actions being taken to remove liquids from secondary containment.

III.10.K.1.a.xix. All air pollution control devices and capture systems in the HLW Vitrification System ~~shall~~ will be maintained and operated at all times in a manner so as to minimize the emissions of air contaminants and to minimize process upsets. Procedures for ensuring that the air pollution control devices and capture systems in the HLW Vitrification System are properly operated and maintained so as to minimize the emission of air contaminants and process upsets ~~shall~~ will be established.

III.10.K.1.a.xx. In all future narrative permit submittals, the Permittees ~~shall~~ will include HLW Vitrification sub-system names with the sub-system designation.

III.10.K.1.a.xxi. For any portion of the HLW Vitrification System which has the potential for formation and accumulation of hydrogen gases, the Permittees ~~shall~~ will operate the portion to maintain hydrogen levels below the lower explosive limit [WAC 173-303-815(2)(b)(ii)].

III.10.K.1.a.xxii. For each HLW Vitrification System sub-system holding dangerous waste which are acutely or chronically toxic by inhalation, the Permittees ~~shall~~ will operate the system to prevent escape of vapors, fumes, or other emissions into the air [WAC 173-303-806(4)(i)(i)(B) and WAC 173-303-640(5)(e), in accordance with WAC 173-303-680].

III.10.K.1.b. Performance Standards

III.10.K.1.b.i. The HLW Vitrification System must achieve a destruction and removal efficiency (DRE) of 99.99% for the principal organic dangerous constituents (PODCs) listed below [40 CFR §63.1203(c)(1) and 40CFR §63.1203(c)(2), in accordance with WAC 173-303-680(2)]:

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DRE in this Permit Condition ~~shall~~ will be calculated in accordance with the formula given below:

$DRE=[1-(W_{out}/W_{in})] \times 100\%$

Where:

W_{in}=mass feed-rate of one principal organic dangerous constituent (PODC) in a waste feedstream; and

W_{out}=mass emission rate of the same PODC present in exhaust emissions prior to release to the atmosphere.

III.10.K.1.b.ii. Particulate matter emissions from the HLW Vitrification System ~~shall~~ will not exceed 34 mg/dscm (0.015 grains/dscf) [40 CFR §63.1203(b)(7), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.iii. Hydrochloric acid and chlorine gas emissions from the HLW Vitrification System ~~shall~~ will not exceed 21 ppmv, combined [40 CFR §63.1203(b)(6), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.iv. Dioxin and Furan TEQ emissions from the HLW Vitrification System ~~shall~~ will not exceed 0.2 nanograms (ng)/dscm [40 CFR §63.1203(b)(1), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.v. Mercury emissions from the HLW Vitrification System ~~shall~~ will not exceed 45 µg/dscm [40 CFR §63.1203(b)(2), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.vi. Lead and cadmium emissions from the HLW Vitrification System ~~shall~~ will not exceed 120 µg/dscm, combined [40 CFR §63.1203(b)(3), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.vii. Arsenic, beryllium, and chromium emissions from the HLW Vitrification System ~~shall~~ will not exceed 97 µg/dscm, combined [40 CFR §63.1203(b)(4), in accordance with WAC 173-303-680(2)];

III.10.K.1.b.viii. Carbon monoxide (CO) emission from the HLW Vitrification System ~~shall~~ will not exceed 100 parts per million (ppm) by volume, over an hourly rolling average (as measured and recorded by the continuous monitoring system), dry basis [40 CFR §63.1203(b)(5)(i), in accordance with WAC 173-303-680(2) and (3)];

III.10.K.1.b.ix. Hydrocarbon emission from the HLW Vitrification System ~~shall~~ will not exceed 10 parts per million (ppm) by volume, over an hourly rolling average (as measured and recorded by the continuous monitoring system during demonstration testing required by this Permit), dry basis and reported as propane [40 CFR §63.1203(b)(5)(ii), in accordance with WAC 173-303-680(2) and (3)];

III.10.K.1.b.x. If the emissions from the HLW Vitrification System exceed the emission rates listed in Permit Table III.10.K.E, as approved pursuant to Permit Condition III.10.C.11.c. or d., the Permittees ~~shall~~ will perform the following actions [WAC 173-303-680(2) and (3), and WAC 173-303-815(2)(b)(ii)]:

A. Verbally notify Ecology within twenty-four (24) hours of the discovery of exceeding the emission rate(s) as specified in Permit Condition I.E.21;

B. Submit to Ecology additional risk information to indicate that the increased emissions impact is off-set by decreased emission impact from one or more constituents expected to be emitted at the same time, and/or investigate the cause and impact of the exceedence of the emission rate(s) and submit a report of the investigation findings to Ecology within fifteen (15) days of the discovery of exceeding the emission rate(s); and

C. Based on the notification and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or to submit a revised Demonstration Test Plan as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring.

The emission limits specified in Permit Conditions III.10.K.1.b.i. through x. above, ~~shall~~ will be met for the HLW Vitrification System by limiting feed rates as specified in Permit Tables III.10.K.D and III.10.K.F, as approved/modified pursuant to Permit Condition III.10.J.5 and III.10.J.3.d.v., compliance with operating conditions specified in Permit

Condition III.10.K.1.c. (except as specified in Permit Condition III.10.K.1.b.xii.), and compliance with Permit Condition III.10.K.1.b.xi.

III.10.K.1.b.xi. Treatment effectiveness, feed-rates, and operating rates for dangerous and/or mixed waste management units contained in the HLW Building, but not included in Permit Table III.10.K.A, as approved/modified pursuant to Permit Condition III.10.J.5, ~~shall~~ will be as specified in Permit Sections III.10.D, III.10.E, III.10.F and consistent with the assumptions and basis which are reflected in Operating Unit 10, Appendix 6.3.1 of this Permit, as approved pursuant to Permit Condition III.10.C.11.b. For the purposes of this permit condition, Operating Unit 10, Appendix 6.3.1 ~~shall~~ will be superceded by Appendix 6.4.1 upon its approval pursuant to either Permit Conditions III.10.C.11.c. or d. [WAC 173-303-680(2) and (3), and WAC 173-303-815(2)(b)(ii)].

III.10.K.1.b.xii. Compliance with the operating conditions specified in Permit Condition III.10.K.1.c., ~~shall~~ will be regarded as compliance with the required performance standards identified in Permit Conditions III.10.K.1.b.i. through x. However, if it is determined that during the effective period of this Permit that compliance with the operating conditions in Permit Condition III.10.K.1.c. is not sufficient to ensure compliance with the performance standards specified in Permit Conditions III.10.K.1.b.i. through x., the Permit may be modified, revoked, or reissued pursuant to Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g.

III.10.K.1.c. Operating Conditions [WAC-303-670(6), in accordance with WAC 173-303-680(2)and (3)]

The Permittees ~~shall~~ will operate the HLW Vitrification System in accordance with Operating Unit 10, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., Operating Unit 10, Appendix 10.18 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e. and f., and Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., except as modified pursuant to Permit Conditions III.10.J.3, III.10.K.1.b.x., III.10.K.1.b.xii., III.10.K.1.h., and in accordance with and the following:

III.10.K.1.c.i. The Permittees ~~shall~~ will operate the HLW Vitrification System in order to maintain the systems and process parameters listed in Permit Tables III.10.K.C and III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., within the set-points specified in Permit Table III.10.K.F.

III.10.K.1.c.ii. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., to automatically cut-off and/or lock-out the dangerous and/or mixed waste feed to HLW Vitrification System when the monitored operating conditions deviate from the set-points specified in Permit Table III.10.K.F.

III.10.K.1.c.iii. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., to automatically cut-off and/or lock-out the dangerous and/or mixed waste feed to HLW

Vitrification System when all instruments specified on Permit Table III.10.I.F for measuring the monitored parameters fails or exceeds its span value.

III.10.K.1.c.iv. The Permittees ~~shall~~ will operate the AWFCO systems, specified in Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., to automatically cut-off and/or lock out the dangerous and/or mixed waste feed to the HLW Vitrification System when any portion of the HLW Vitrification System is bypassed. The terms "bypassed" and "bypass event" as used in Permit Sections III.10.J and K ~~shall~~ will mean if any portion of the HLW Vitrification System is bypassed so that gases are not treated as during the Demonstration Test.

III.10.K.1.c.v. In the event of a malfunction of the AWFCO systems listed in Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., the Permittees ~~shall~~ will immediately, manually, cut-off the dangerous and/or mixed waste feed to the HLW Vitrification System. The Permittees ~~shall~~ will not restart the dangerous and/or mixed waste feed until the problem causing the malfunction has been identified and corrected.

III.10.K.1.c.vi. The Permittees ~~shall~~ will manually cut-off the dangerous and/or mixed waste feed to the HLW Vitrification System when the operating conditions deviate from the limits specified in Permit Condition III.10.K.1.c.i., unless the deviation automatically activates the waste feed cut-off sequence specified in Permit Conditions III.10.K.1.c.ii., iii., and/or iv.

III.10.K.1.c.vii. If greater than thirty (30) dangerous and/or mixed waste feed cut-off, combined, to the HLW Vitrification System occur due to deviations from Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., within a sixty (60) day period, the Permittees ~~shall~~ will submit a written report to Ecology within five (5) calendar days of the thirty-first (31) exceedence including the information specified below. These dangerous and/or mixed waste feed cut-offs to the HLW Vitrification System, whether automatically or manually activated, are counted if the specified set-points are deviated from while dangerous and/or mixed waste and waste residues continue to be processed in the HLW Vitrification System. A cascade event is counted at a frequency of one (1) towards the first waste feed cut-off parameter, specified on Permit Table III.10.K.F, from which the set-point is deviated:

A. The parameter(s) that deviated from the set-point(s) in Permit Table III.10.K.F;

B. The magnitude, dates, and duration of the deviations;

C. Results of the investigation of the cause of the deviations; and

D. Corrective measures taken to minimize future occurrences of the deviations.

III.10.K.1.c.viii. If greater than thirty (30) dangerous and/or mixed waste feed cut-off, combined, to the HLW Vitrification System occur due to deviations from Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., within a thirty (30) day period, the Permittees ~~shall~~ will submit the written report required to be submitted pursuant to Permit Condition III.10.K.1.c.vii. to Ecology, on the first business day following the thirty-first exceedence. These dangerous and/or mixed waste feed cut-offs to the HLW Vitrification System, whether automatically or manually activated, are counted if the specified set-points are deviated from while dangerous and/or mixed waste and waste residues continue to be processed in the HLW Vitrification System. A cascade event is counted at a frequency of one (1) towards the first waste feed cut-off parameter, specified on Permit Table III.10.K.F, from which the set-point is deviated:

In accordance with WAC 173-303-680(2) and (3), the Permittees may not resume dangerous and/or mixed waste feed to the HLW Vitrification System until this written report has been submitted; and

A. Ecology has authorized the Permittees, in writing, to resume dangerous and/or mixed waste feed, or

B. Ecology has not, within seven (7) days, notified the Permittees in writing of the following:

1. The Permittees written report does not document that the corrective measures taken will minimize future exceedances; and

2. The Permittees must take further corrective measures and document that these further corrective measures will minimize future exceedances.

III.10.K.1.c.ix. If any portion of the HLW Vitrification System is bypassed while treating dangerous and/or mixed waste, it ~~shall~~ will be regarded as non-compliance with the operating conditions specified in Permit Condition III.10.K.1.c. and the performance standards specified in Permit Condition III.10.K.1.b. After such a bypass event, the Permittees ~~shall~~ will perform the following actions:

A. Investigate the cause of the bypass event;

B. Take appropriate corrective measures to minimize future bypasses;

C. Record the investigation findings and corrective measures in the operating record; and

D. Submit a written report to Ecology within five (5) days of the bypass event documenting the result of the investigation and corrective measures.

III.10.K.1.c.x. The Permittees ~~shall~~ will control fugitive emissions from the HLW Vitrification System by maintaining the melter under negative pressure.

III.10.K.1.c.xi. Compliance with the operating conditions specified in Permit Condition III.10.K.1.c. ~~shall~~ will be regarded as compliance with the required performance standards identified in Permit Condition III.10.K.1.b. However, evidence that compliance with these operating conditions is insufficient to ensure compliance with the performance standards, ~~shall~~ will justify modification, revocation, or re-issuance of this Permit, in accordance with Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g.

III.10.K.1.d. Inspection Requirements [WAC 173-303-680(3)]

III.10.K.1.d.i. The Permittees ~~shall~~ will inspect the HLW Vitrification System in accordance with the Inspection Schedules in Operating Unit 10, Chapter 6.0 of this Permit, as modified in accordance with Permit Condition III.10.C.5.c.

III.10.K.1.d.ii. The inspection data for HLW Vitrification System ~~shall~~ will be recorded, and the records ~~shall~~ will be placed in the WTP Unit operating record for HLW Vitrification System, in accordance with Permit Condition III.10.C.4.

III.10.K.1.d.iii. The Permittees ~~shall~~ will comply with the inspection requirements specified in Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.J.3, III.10.K.1.b.x., III.10.K.1.b.xii., and III.10.K.1.h.

III.10.K.1.e. Monitoring Requirements [WAC 173-303-670(5), WAC 173-303-670(6), WAC 173-303-670(7), and WAC 173-303-807(2), in accordance with WAC 173-303-680(3)]

III.10.K.1.e.i. Upon receipt of a written request from Ecology, the Permittees ~~shall~~ will perform sampling and analysis of the dangerous and/or mixed waste and exhaust emissions to verify that the operating requirements established in the permit achieve the performance standards delineated in this Permit.

III.10.K.1.e.ii. The Permittees ~~shall~~ will comply with the monitoring requirements specified in the Operating Unit 10, Appendices 10.2, 10.3, 10.7, 10.13, 10.15, and 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5, and as modified by Permit Conditions III.10.J.3, III.10.K.1.h., and III.10.K.1.b.x. and xii.

III.10.K.1.e.iii. The Permittees ~~shall~~ will operate, calibrate, and maintain the carbon monoxide and hydrocarbon continuous emission monitors (CEM) specified in this Permit in accordance with Performance Specifications 4B and 8A of 40 CFR Part 60, Appendix B, in accordance with Appendix to Subpart EEE of 40 CFR Part 63, and Operating Unit 10 Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.H.3, III.10.K.1.h., and III.10.K.1.b.x. and xii.

III.10.K.1.e.iv. The Permittees ~~shall~~ will operate, calibrate, and maintain the instruments specified on Permit Tables III.10.K.C and E, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., in accordance with Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., and as modified by Permit Conditions III.10.J.3, III.10.K.1.h., and III.10.K.1.b.x. and xii.

III.10.K.1.f. Recordkeeping Requirements [WAC 173-303-380 and WAC 173-303-680(3)]

III.10.K.1.f.i. The Permittees ~~shall~~ will record and maintain in the WTP Unit operating record for the HLW Vitrification System, all monitoring, calibration, maintenance, test data, and inspection data compiled under the conditions of this Permit, in accordance with Permit Conditions III.10.C.4 and 5 as modified by Permit Conditions III.10.J.3, III.10.K.1.h., and III.10.K.1.b.x. and xii.

III.10.K.1.f.ii. The Permittees ~~shall~~ will record in the WTP Unit operating record the date, time, and duration of all automatic waste feed cut-offs and/or lockouts, including the triggering parameters, reason for the deviation, and recurrence of the incident. The Permittees ~~shall~~

will also record all incidents of AWFCO system function failures, including the corrective measures taken to correct the condition that caused the failure.

III.10.K.1.f.iii. The Permittees ~~shall~~ will submit to Ecology an annual report each calendar year within ninety (90) days following the end of the year. The report will include the following information:

A. Total dangerous and/or mixed waste feed processing time for the HLW Vitrification System;

B. Date/Time of all HLW Vitrification System startups and shutdowns;

C. Date/Time/Duration/Cause/Corrective Action taken for all HLW Vitrification System shutdowns caused by malfunction of either process or control equipment; and

D. Date/Time/Duration/Cause/Corrective Action taken for all instances of dangerous and/or mixed waste feed cut-off due to deviations from Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.10J.3.d.v.

III.10.K.1.f.iv. The Permittees ~~shall~~ will submit an annual report to Ecology each calendar year within ninety (90) days following the end of the year of all quarterly CEM Calibration Error and Annual CEM Performance Specification Tests conducted in accordance with Permit Condition III.10.K.1.e.iii.

III.10.K.1.g. Closure

The Permittees ~~shall~~ will close the HLW Vitrification System in accordance with Operating Unit 10, Chapter 11.0 of this Permit, as approved pursuant to Permit Condition III.10.C.8.

III.10.K.1.h. Periodic Emission Re-testing Requirements [WAC 173-303-670(5), WAC 173-303-670(7), and WAC 173-303-807(2), in accordance with WAC 173-303-680(2) and (3)]

III.10.K.1.h.i. Dioxin and Furan Emission Testing

A. Within eighteen (18) months of commencing operation pursuant to Permit Section III.10.K, the Permittees ~~shall~~ will submit to Ecology for approval, a Dioxin and Furan Emission Test Plan (DFETP) for the performance of emission testing of the HLW Vitrification System gases for dioxin and furans during "Normal Operating Conditions" as a permit modification in accordance with Permit Conditions III.10.C.2.e. and f. The DFETP ~~shall~~ will include all elements applicable to dioxin and furan emission testing included in the "Previously Approved Demonstration Test Plan," applicable EPA promulgated test methods and procedures in effect at the time of the submittal, and projected commencement and completion dates for dioxin and furan emission test. "Normal Operating Conditions" ~~shall~~ will be defined for the purposes of this permit condition as follows:

1. Carbon monoxide emissions, dangerous and/or mixed waste feed-rate, and automatic waste feed cut-off parameters specified on Permit Table III.10.K.F (as approved/modified pursuant to Permit Conditions III.10.J.5 and III.10.J.3.d.v), that were established to maintain compliance with Permit

Condition III.10.K.1.b.iv., as specified in Operating Unit 10, Appendix 10.15 of this Permit (as approved pursuant to Permit Condition III.10.J.3.d. and in accordance with III.10.K.1.b.xii. and III.10.K.1.c.xi.), are held within the range of the average value over the previous twelve (12) months and the set-point value specified on Permit Table III.10.K.F. The average value is defined as the sum of the rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include calibration data, malfunction data, and data obtained when not processing dangerous and/or mixed waste; and

2. Feed-rate of metals, ash, and chlorine/chloride are held within the range of the average value over the previous twelve (12) months and the set-point value specified on Permit Table III.10.K.D (as approved/modified pursuant to Permit Conditions III.10.J.5 and III.10.J.3.d.v). Feed-rate of organics as measured by TOC are held within the range of the average value over the previous twelve (12) months. The average value is defined as the sum of the rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include data obtained when not processing dangerous and/or mixed waste.

For purposes of this permit Condition, the "Previously Approved Demonstration Test Plan" is defined to include the Demonstration Test Plan approved pursuant to Permit Condition III.10.J.5.f.

B. Within sixty (60) days of Ecology's approval of the DFETP, or within thirty-one (31) months of commencing operation pursuant to Permit Section III.10.K, whichever is later, the Permittees ~~shall~~ will implement the DFETP approved, pursuant to Permit Condition III.10.K.1.h.i.A.

C. The Permittees ~~shall~~ will resubmit the DFETP, approved pursuant to Permit Condition III.10.K.1.h.i.A, revised to include applicable EPA promulgated test methods and procedures in effect at the time of the submittal, and projected commencement and completion dates for dioxin and furan emission test as a permit modification in accordance with Permit Conditions III.10.C.2.e. and f. at twenty-four (24) months from the implementation date of the testing required pursuant to Permit Condition III.10.K.1.h.i.A and at reoccurring eighteen (18) month intervals from the implementation date of the previously approved DFETP. The Permittees ~~shall~~ will implement these newly approved revised DFETPs every thirty-one (31) months from the previous approved DFETP implementation date or within sixty (60) days of the newly Ecology approved revised DFETP, whichever is later, for the duration of this Permit.

D. The Permittees ~~shall~~ will submit a summary of operating data collected pursuant to the DFETPs in accordance with Permit Conditions III.10.K.1.h.i.A and C to Ecology upon completion of the tests. The Permittees ~~shall~~ will submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports shall will be certified as specified in WAC 173-303-807(8), in accordance with WAC 173-303-680(2) and (3).

E. If any calculations or testing results collected pursuant to the DFETPs in accordance with Permit Conditions III.10.K.1.h.i.A and C show that one or more of the performance standards listed in Permit Condition III.10.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were not met during the emission test, the Permittees shall will perform the following actions:

1. Immediately stop dangerous and/or mixed waste feed to the HLW Vitrification System under the mode of operation that resulted in not meeting the performance standard(s).

2. Verbally notify Ecology within twenty-four (24) hours of discovery of not meeting the performance standard(s) as specified in Permit Condition I.E.21.

3. Investigate the cause of the failure and submit a report of the investigation findings to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s).

4. Submit to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s) documentation supporting a mode of operation where all performance standards listed in Permit Condition III.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were met during the demonstration test, if any such mode was demonstrated.

5. Based on the information provided to Ecology by the Permittees, pursuant to Permit Conditions III.10.K.1.h.i.E.1 through 4 above, and any additional information, Ecology may submit provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or amend the mode of operation the Permittees are allowed to continue operations prior to Ecology approval of the revised Demonstration Test Plan pursuant to Permit Condition III.10. K.1.h.i.E.6.

6. Submit to Ecology within one hundred and twenty (120) days of discovery of not meeting the performance standard(s) a revised Demonstration Test Plan requesting approval to retest as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and F.

F. If any calculations or testing results collected pursuant to the DFETPs in accordance with Permit Conditions III.10.K.1.h.i.A and C show that any emission rate for any constituent listed in Permit Table III.10.K.E, as approved/modified pursuant to

Permit Conditions III.10.C.11.c. or d., is exceeded for HLW Vitrification System during the emission test, the Permittees ~~shall~~ will perform the following actions:

1. Verbally notify Ecology within twenty-four (24) hours of the discovery of exceeding the emission rate(s) as specified in Permit Condition I.E.21;

2. Submit to Ecology additional risk information to indicate that the increased emissions impact is off-set by decreased emission impact from one or more constituents expected to be emitted at the same time, and/or investigate the cause and impact of the exceedence and submit a report of the investigation findings to Ecology within fifteen (15) days of this discovery of exceeding the emission rate(s); and

3. Based on the notification and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or to submit a revised Demonstration Test Plan as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and F.

III.10.K.1.h.ii. Non-organic Emission Testing

A. Within forty-eight (48) months of commencing operation pursuant to Permit Section III.10.K, the Permittees ~~shall~~ will resubmit to Ecology for approval the "Previously Approved Demonstration Test Plan" revised as a permit modification in accordance with Permit Conditions III.10.C.2.e. and f. The revised Demonstration Test Plan (RDTP) ~~shall~~ will include applicable EPA promulgated test methods and procedures in effect at the time of the submittal, projected commencement and completion dates for emission testing to demonstrate performance standards specified in Permit Conditions III.10.K.1.b.ii., iii., v., vi., and vii., and non-organic emissions as specified in Permit Table III.10.K.E, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d., under "Normal Operating Conditions." "Normal Operating Conditions" ~~shall~~ will be defined for the purposes of this permit condition as follows:

1. Carbon monoxide emissions, dangerous and/or mixed waste feed-rate, and automatic waste feed cut-off parameters specified in Permit Table III.10.K.F, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d., that were established to maintain compliance with Permit Conditions III.10.K.1.b.ii., iii., v., vi., and vii., and non-organic emissions, as specified in Permit Table III.10.K.E, as specified in Operating Unit 10, Appendix 10.15 of this Permit (as approved pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d.), are held within the range of the average value over the previous twelve (12) months and the set-point value specified on Permit Table III.10.K.F. The average value is defined as the sum of the

rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include calibration data, malfunction data, and data obtained when not processing dangerous and/or mixed waste; and

2. Feed-rate of metals, ash, and chlorine/chloride are held within the range of the average value over the previous twelve (12) months and the set-point value specified on Permit Table III.10.K.D, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d. The average value is defined as the sum of all rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include data obtained when not processing dangerous and/or mixed waste.

For purposes of this permit Condition, the "Previously Approved Demonstration Test Plan" is defined to include the Demonstration Test Plan approved pursuant to Permit Condition III.10.J.5.f.

B. Within sixty (60) days of Ecology's approval of the RDTP, or within sixty (60) months of commencing operation pursuant to Permit Section III.10.K, whichever is later, the Permittees ~~shall~~ will implement the RDTP approved pursuant to Permit Condition III.10.K.1.h.ii.A.

C. The Permittees ~~shall~~ will resubmit the RDTP, approved pursuant to Permit Condition III.10.K.1.h.ii.A, revised to include applicable EPA promulgated test methods and procedures in effect at the time of the submittal, and projected commencement and completion dates for emission test as a permit modification in accordance with Permit Conditions III.10.C.2.e. and f. at forty-eight (48) months from the implementation date of the testing required pursuant to Permit Condition III.10.K.1.h.ii.A and at reoccurring forty-eight (48) month intervals from the implementation date of the previously approved RDTP. The Permittees ~~shall~~ will implement these newly approved revised RDTP, every sixty (60) months from the previous approved RDTP implementation date or within sixty (60) days of the newly Ecology approved revised RDTP, whichever is later, for the duration of this Permit.

D. The Permittees ~~shall~~ will submit a summary of operating data collected pursuant to the RDTPs in accordance with Permit Conditions III.10.K.1.h.ii.A and C to Ecology upon completion of the tests. The Permittees ~~shall~~ will submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports ~~shall~~ will be certified pursuant to WAC 173-303-807(8), in accordance with WAC 173-303-680(2) and (3).

E. If any calculations or testing results collected pursuant to the DFETPs in accordance with Permit Conditions III.10.K.1.h.ii.A and C show that any emission rate for any constituent listed in Permit Table III.10.K.E, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d., is exceeded for HLW Vitrification System during the emission test, the Permittees ~~shall~~ will perform the following actions:

1. Verbally notify Ecology within twenty-four (24) hours of the discovery of exceeding the emission rate(s) as specified in Permit Condition I.E.21;

2. Submit to Ecology additional risk information to indicate that the increased emissions impact is off-set by decreased emission impact from one or more constituents expected to be emitted at the same time, and/or investigate the cause and impact of the exceedence and submit a report of the investigation findings to Ecology within fifteen (15) days of this discovery of exceeding the emission rate(s); and

3. Based on the notification and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or to submit a revised Demonstration Test Plan as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and III.10.K.F.

F. If any calculations or testing results collected pursuant to the DFETPs in accordance with Permit Conditions III.10.K.1.h.ii.A and C show that one or more of the performance standards listed in Permit Condition III.10.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were not met during the emission test, the Permittees ~~shall~~ will perform the following actions:

1. Immediately stop dangerous and/or mixed waste feed to the HLW Vitrification System under the mode of operation that resulted in not meeting the performance standard(s).

2. Verbally notify Ecology within twenty-four (24) hours of discovery of not meeting the performance standard(s), as specified in Permit Condition I.E.21.

3. Investigate the cause of the failure and submit a report of the investigation findings to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s).

4. Submit to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s) documentation supporting a mode of operation where all performance standards listed in Permit Condition III.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were met during the demonstration test, if any such mode was demonstrated.

5. Based on the information provided to Ecology by the Permittees pursuant to Permit Conditions III.10.K.1.h.ii.F.1 through 4 above, and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or amend the mode of operation the Permittees are

allowed to continue operations prior to Ecology approval of the revised Demonstration Test Plan pursuant to Permit Condition III.10.K.1.h.ii.F.6.

6. Submit to Ecology within one hundred and twenty (120) days of discovery of not meeting the performance standard(s) a revised Demonstration Test Plan requesting approval to retest as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and F.

III.10.K.1.h.iii. Other Emission Testing

A. Within seventy-eight (78) months of commencing operation pursuant to Permit Section III.10.K, the Permittees ~~shall~~ will resubmit to Ecology for approval the "Previously Approved Demonstration Test Plan" revised as a permit modification in accordance with Permit Conditions III.10.C.2.e. and f. The revised Demonstration Test Plan (RDTP) ~~shall~~ will include applicable EPA promulgated test methods and procedures in effect at the time of the submittal, projected commencement and completion dates for emission testing to demonstrate performance standards as specified in Permit Conditions III.10.K.1.b.viii. and ix., and emissions as specified on Permit Table III.10.K.E, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d., not addressed under Permit Conditions III.10.K.1.h.i. or ii. under "Normal Operating Conditions." "Normal Operating Conditions" ~~shall~~ will be defined for the purposes of this permit Condition as follows:

1. Carbon monoxide emissions, dangerous and/or mixed waste feed-rate, and automatic waste feed cut-off parameters specified on Permit Table III.10.K.F, as approved/modified pursuant to Permit Condition III.10.J.3.d. and III.10.C.11.c. or d., that were established to maintain compliance with Permit Conditions III.10.K.1.b.viii. and ix., and emissions as specified on Permit Table III.10.K.E, not addressed under Permit Conditions III.10.K.1.h.i. or ii. as specified in Operating Unit 10, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.3.d., and in accordance with Permit Conditions III.10.K.1.b.xii. and III.10.K.1.c.xi. are held within the range of the average value over the previous twelve (12) months and the set-point value specified on Permit Table III.10.K.F. The average value is defined as the sum of all rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include calibration data, malfunction data, and data obtained when not processing dangerous and/or mixed waste; and

2. Feed-rate of metals, ash, and chlorine/chloride are held within the range of the average value over the previous twelve (12) months and the set-point

value specified on Permit Table III.10.K.D, as approved/modified pursuant to Permit Conditions III.10.J.3.d. and III.10.C.11.c. or d. Feed-rate of organics as measured by TOC are held within the range of the average value over the previous twelve (12) months. The average value is defined as the sum of the rolling average values recorded over the previous twelve (12) months divided by the number of rolling averages recorded during that time. The average value ~~shall~~ will not include data obtained when not processing dangerous and/or mixed waste.

For purposes of this permit Condition, the "Previously Approved Demonstration Test Plan" is defined to include the Demonstration Test Plan approved pursuant to Permit Condition III.10.J.5.f.

B. Within sixty (60) days of Ecology's approval of the RDTP, or within ninety-one (91) months of commencing operation pursuant to Permit Section III.10.K, whichever is later, the Permittees ~~shall~~ will implement the RDTP approved pursuant to Permit Condition III.10.K.1.h.iii.A.

C. The Permittees ~~shall~~ will submit a summary of operating data collected pursuant to the RDTPs in accordance with Permit Condition III.10.K.1.h.iii.A to Ecology upon completion of the tests. The Permittees ~~shall~~ will submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports ~~shall~~ will be certified as specified in WAC 173-303-807(8), in accordance with Permit Condition WAC 173-303-680(2) and (3).

D. If any calculations or testing results show that one or more of the performance standards listed in Permit Condition III.10.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were not met during the emission test, the Permittees ~~shall~~ will perform the following actions:

1. Immediately stop dangerous and/or mixed waste feed to the HLW Vitrification System under the mode of operation that resulted in not meeting the performance standard(s).
2. Verbally notify Ecology within twenty-four (24) hours of discovery of not meeting the performance standard(s), as specified Permit Condition I.E.21.
3. Investigate the cause of the failure and submit a report of the investigation findings to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s).
4. Submit to Ecology within fifteen (15) days of discovery of not meeting the performance standard(s) documentation supporting a mode of operation where all performance standards listed in Permit Condition III.10.K.1.b., with the exception of Permit Condition III.10.K.1.b.x., for the HLW Vitrification System were met during the demonstration test, if any such mode was demonstrated.

5. Based on the information provided to Ecology by the Permittees pursuant to Permit Conditions III.10.K.1.h.iii.D.1 through 4 above, and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or amend the mode of operation the Permittees are allowed to continue operations prior to Ecology approval of the revised Demonstration Test Plan, pursuant to Permit Condition III.10.K.1.h.iii.D.6.

6. Submit to Ecology within one hundred and twenty (120) days of discovery of not meeting the performance standard(s) a revised Demonstration Test Plan requesting approval to retest as a permit modification pursuant to Permit Conditions II.10.C.2.e. and f. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and F.

E. If any calculations or testing results show that any emission rate for any constituent listed in Permit Table III.10.K.E, as approved/modified pursuant to Permit Condition III.10.C.11.c. or d., is exceeded for HLW Vitrification System during the emission test, the Permittees ~~shall~~ will perform the following actions:

1. Verbally notify Ecology within twenty-four (24) hours of the discovery of exceeding the emission rate(s) as specified in Permit Condition I.E.21;

2. Submit to Ecology additional risk information to indicate that the increased emissions impact is off-set by decreased emission impact from one or more constituents expected to be emitted at the same time, and/or investigate the cause and impact of the exceedence of the emission rate(s) and submit a report of the investigation findings to Ecology within fifteen (15) days of the discovery of the exceedence of the emission rate(s); and

3. Based on the notification and any additional information, Ecology may ~~submit~~ provide, in writing, direction to the Permittees to stop dangerous and/or mixed waste feed to the HLW Vitrification System and/or to submit a revised Demonstration Test Plan as a permit modification pursuant to Permit Conditions III.10.C.2.e. and f., or III.10.C.2.g. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring reflecting performance under operating conditions representative of the extreme range of normal conditions, and include revisions to Permit Tables III.10.K.D and F.

Table III.10.K.A - HLW Vitrification System Description

Sub-system Description	Subsystem Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables and Figures
HLW Concentrate Receipt Process System & HLW Melter Feed Process System (Comprised of the following: Feed Preparation Vessels - HFP-VSL-00001/5[a];	HFP HCP	24590-HLW -3YD-HFP-00001 -M5-V17T-P0001 -M6-HFP-P0001 -M6-HFP-P0002 -M6-HFP-P20001 -M6-HFP-P20002 -PER-J-04-0001	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter Feed Vessel -HFP-VSL-00002/6[a] (HLW Melter Feed Process System)	HFP	24590-HLW -3YD-HFP-00001 -M5-V17T-P0001 -M6-HFP-P0002 -M6-HFP-P20002 -PER-J-04-0001	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter Process System (Comprised of the following: HLW Melter 1/2 -HMP-MLTR-00001/2)	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27, 4A-54; Table 4-14
HLW Glass Product System-Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
Melter Offgas Treatment Process System (Comprised of the following: Offgas Film Cooler - Melter 1/2 -HOP-FCLR-00001/2)	HOP	RESERVED 24590-HLW -3YD-HOP-00001 -M5-V17T-P0002 -M5-V17T-P20002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27; Table 4-14

Melter Offgas Treatment Process System (Comprised of the following: HLW Submerged Bed Scrubbers - /Condensate Collection Vessels –HOP-SCB-00001/2 – Melters 1 & 2)	HOP	24590-HLW -3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0001 -M6-HOP-P20001 -M6-HMP-P0002 -M6-HMP-P20002 -MKD-HOP-P0016 -MK-HOP-P0001001 -MK-HOP-P0001002 -MK-HOP-P0001003 -MK-HOP-P0001004 -MVD-HOP-P0015 -MVD-HOP-P0016 -N1D-HOP-P0010 -P1-P01T-P0002 24590-WTP -3PS-MV00-TP001 -3PS-MV00-TP002 -3PS-MV00-TP003	Section 4.1.4.3; Table 4-5 & Table 4-14, Figures 4A-1, 4A-4, 4A-28
SBS Condensate Receiver Vessels (HOP-VSL-00903, HOP-VSL-000904[a]	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0004 -M6-HOP-P0006 -M6-HOP-P0008 -M6-HOP-P20003 -M6-HOP-P20008 -MVD-HOP-P0001 -MV-HOP-P0001 -MV-HOP-P0003 -N1D-HOP-P0006	Section 4.1.4.3; Table 4-5 &, Figures 4A-1, 4A-4, 4A-28

Melter Offgas Treatment Process System (Comprised of the following: Wet Electrostatic Precipitator-Melter 1&2 HOP-WESP-00001 HOP-WESP-00002)	HOP	**24590-HLW** -3YD-HOP-00001 ~~-HOP-WESP-00001~~ ~~-HOP-WESP-00002~~ -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0002 -M6-HOP-P20002 -N1D-HOP-P0002 -P1-P01T-P0004 -P1-P01T-P0005 24590-WTP-3PS- MKE0-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-28;~~ Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Particulate Air (HEPA) Filters -Melters 1 & 2 -HOP-HEPA-1A/1B -HOP-HEPA-2A/2B ~~-HOP-HEPA-00012A/B~~ -HOP-HEPA-00007A/7B -HOP-HEPA-00008A/8B ~~-HOP-HEPA-00013A/B)~~	HOP	**24590-HLW** -3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0010 -M6-HOP-P20010 -MAD-HOP-P0010 -MAD-HOP-P0011 -MAD-HOP-P0012 -MAD-HOP-P0013 -MAD-HOP-P0014 -MAD-HOP-P0015 -MAD-HOP-P0016 -MAD-HOP-P0017 -P1-P01T-P0002 24590-WTP-3PS- MKH0-TP002	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29;~~ Table 4-14
Melter Offgas Treatment Process	HOP	**24590-HLW**	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29;~~ Table 4-14

System (Comprised of the following: Activated Carbon Adsorber HOP-ADBR-00001A/1B/2A/2B)		-M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MVD-HOP-P0015 -MVD-HOP-P0016 -N1D-HOP-P0003 -P1-P01T-P0002 24590-WTP-3PS-MWK0-TP001	
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Mist Eliminators - Melters 1/2 -HOP-HEME-00001A/1B/2A/2B)	HOP	**24590-HLW** 3YD-HOP-00001 -M5-V17T-P0003 -M5-V17T-P20003 ~~-M6-HOP-P0002~~ -M6-HOP-P0009 -M6-HOP-P20009 ~~-MKD-HOP-P0007~~ -MVD-HOP-P0007 ~~-MVD-HOP-P0015~~ ~~-MVD-HOP-P0016~~ -MV-HOP-P0002001 -MV-HOP-P0002002 -MV-HOP-P0002003 -N1D-HOP-P0001 -P1-P01T-P0002	Section 4.1.4.3; Figures 4A-1, 4A-4, ~~4A-28~~; Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: Thermal Catalytical Oxidation Unit-HOP-SCO-00001/4) [located on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003]	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29~~; Table 4-14

		-N1D-HOP-P0004 -N1D-HOP-P0005 -P1-PO1T-P0002 24590-WTP-3PS- MBTV-TP001	
Melter Offgas Treatment Process System (Comprised of the following: NOx Selective Catalytical Reduction Unit-HOP-SCR-00001/2 [located on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003])	HOP	~~RESERVED~~ **24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -N1D-HOP-P0004 -N1D-HOP-P0005 -P1-PO1T-P0002 24590-WTP-3PS- MBTV-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29~~; Table 4-14
Catalyst Skid Preheaters (HOP-HX-00001, HOP-HX-00003), on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MKD-HOP-P0019 -MKD-HOP-P0020 -P1-PO1T-P0002 24590-WTP-3PS- MBTV-TP001	Section 4.1.4.3.2; Table 4-14; Figures 4A-1, 4A-4, 4A-29
Catalyst Skid Electric Heaters (HOP-HTR-00001, HOP-HTR-00007), on Catalyst Skids HOP-SCO-00002 and HOP-SCO-00003	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008	Section 4.1.4.3.2; Table 4-14; Figures 4A-1, 4A-4, 4A-29

		-MKD-HOP-P0019 -MKD-HOP-P0020 -P1-PO1T-P0002 24590-WTP-3PS- MBTV-TP001	
Melter Offgas Treatment Process System (Comprised of the following: ~~Melter 1~~ Silver Mordenite Column HOP-ABS-00002, ~~Melter 2~~ Silver Mordenite Column-HOP-ABS-00003)	HOP	**24590-HLW** -3PS-MBT0-TP001 -M5-V17T-P0004 -M5-V17T-P20004 ~~-M6-HOP-P0003~~ -M6-HOP-P0008 ~~-M6-HOP-P20003~~ -M6-HOP-P20008 -MKD-HOP-P0014 -MKD-HOP-P0017 -NID-HOP-P0006 -P1-P01T-P0001	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29~~; Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: High Efficiency Particulate Air (HEPA) Preheaters ~~Electric Heaters~~-HOP-HTR-00002A/1B, HOP-HTR-00005A/5B	HOP	**24590-HLW** -3PS-MEE0-TP001 -M5-V17T-P0003 -M5-V17T-P20003 -M6-HOP-P0010 -M6-HOP-P20010 -MED-HOP-P0013	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29~~; Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: ~~Heat Exchangers ME~~ Silver Mordenite Preheaters HOP-HX-00002/4)	HOP	**24590-HLW** M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MED-HOP-P0012 -MED-HOP-P0017 -N1D-HOP-P0007 -P1-P01T-P0002	Section 4.1.4.3; Figures 4A-1, 4A-4~~, 4A-29~~; Table 4-14

Pumps-HFP-EDUC-00001/2/3/4	HFP/HOP	24590-HLW -M6-HFP-P0001 -M6-HFP-P0002 -M6-HFP-P20001 -M6-HFP-P20002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27, 4A-28, 4A-29
Melter Offgas Treatment Process System (Comprised of the following: Booster Extraction Fans-MA-HOP-FAN-00001A/1B/1C, MA-HOP-FAN-00009A/9B/9C]	HOP	24590-HLW M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MAD_HOP_P0020 -MAD-HOP-P0018 -MAD-HOP-P0019 -MAD-HOP-P0035 -MAD-HOP-P0036 -MAD-HOP-P0037 -P1-P01T-P0001 24590-WTP-3PS-MACS-TP004	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29; Table 4-14
Stack Extraction Fans-HOP-FAN-00008A/B/C & HOP-FAN-000010A/B/C	HOP	24590-HLW -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0008 -M6-HOP-P20008 -MAD-HOP-P0038 -P1-P01T-P0005 24590-WTP-3PS-MACS-TP004	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29 Table 4-14
Melter Offgas Treatment Process System (Comprised of the following: HLW Stack)	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
	PJV (HLW	24590-HLW	

Electric (PJV-HTR-00002)]	~~Pulse Jet Ventilation Treatment System)~~	-M5-V17T-P0005 -M6-PJV-POOO1	
High Efficiency Particulate Air (HEPA)Filters Primary (PJV-HEPA-00004A) High Efficiency Particulate Air Filters – Standby Primary (PJV-HEPA-00004B) High Efficiency Particulate Air Filters – Secondary (PJV-HEPA-00005A) High Efficiency Particulate Air Filters – Standby Secondary (PJV-HEPA-00005B))	PJV ~~(HLW Pulse Jet Ventilation Treatment System)~~	24590-HLW -M5-V17T-P0005 -M6-PJV-P0002	
~~Booster~~ Fans (PJV-FAN-00002A/B))	PJV-~~(HLW Pulse Jet Ventilation Treatment System)~~	24590-HLW -3YD-PJV-00001 -M5-V17T-P0005 -M6-PJV-P0002 -P1-P01T-P0005 24590-WTP-3PS-MACS-TP004	~~RESERVED~~

a. Requirements pertaining to the tanks in ~~HLW Vitrification System Melter Feed System &~~ SBS Condensate Receiver Vessels are specified in Permit Secion III.10.E.

Table III.10.K.B - HLW Vitrification System Secondary Containment Systems Including Sumps and Floor Drains

Sump/Floor Drain I.D.# & Room Location	Maximum Sump Capacity (gallons)	Sump Dimensions (feet) & Materials of Construction	Engineering Description (Drawing Nos., Specification Nos., etc.)
RESERVED	RESERVED	RESERVED	RESERVED

Table III.10.K.C - HLW Vitrification System Process and Leak Detection System Instruments and Parameters

Sub-system Locator and Name (including P&ID)	Control Parameter	Type of Measuring or Leak Detection Instrument	Location of Measuring Instrument (Tag No.)	Instrument Range	Failure State	Expected Range	Instrument Accuracy	Instrument Calibration Method No. and Range
RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED	RESERVED

Table III.10.K.D - Maximum Feed-rates to HLW Vitrification System (RESERVED)

Description of Waste	Normal Operation
Dangerous and/or mixed waste Feed Rate	
Ash Feed Rate	
Total Chlorine/Chloride Feed Rate	
Total Metal Feed-rates	

Table III.10.K.E- HLW Vitrification System Estimated Emission Rates (RESERVED)

Chemicals	CAS Number	Emission Rates (grams /second)

TABLE III.10.K.F - HLW Vitrification System Waste Feed Cut-off Parameters* [1](RESERVED)

Sub-system Designation	Instrument Tag Number	Parameter Description	Set-points During Normal Operation

*A continuous monitoring system ~~shall~~ will be used as defined in Permit Section III.10.C.1.

[1]Maximum Feed-rate ~~shall~~ will be set based on not exceeding any of the constituent (e.g., metals, ash, and chlorine/chloride) feed limits specified on Table III.10.K.D. of this Permit

Chapter 4.0

Process Information

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Appendices

4.0 PROCESS INFORMATION

4.1 PROCESS DESCRIPTION

Mixed waste is managed by the Hanford Tank Waste Treatment and Immobilization Plant (WTP) using tanks, containment buildings, container storage areas, and miscellaneous unit systems. The floors and lower portions of the black cells and hot cell walls are lined with stainless steel for secondary containment. Black cells and hot cells will be equipped with an instrumented sump or sumps for leak detection. Liquids are removed from the black cell sumps by steam ejectors.

The pretreatment facility uses tank systems, miscellaneous unit systems (defined in Chapter 10, Section III.10.G of this Permit), and containment buildings to prepare waste feed from the Hanford Site double-shell tank (DST) system for vitrification. The low-activity waste (LAW) vitrification facility uses miscellaneous treatment unit sub-systems and equipment (defined in Chapter 10, Section III.10.H and III.10.I of this Permit), tank systems, and containment buildings to vitrify LAW feed. The high-level waste (HLW) vitrification facility uses miscellaneous treatment unit sub-systems and equipment (defined in Chapter 10, Section III.10.J and III.10.K of this Permit), tank systems, containment buildings, and container storage areas to vitrify HLW feed. A tank system and a container storage area are used at the analytical laboratory (LAB). Container storage is used in the balance of facilities (BOF) for waste management activities. These waste management activities are discussed in the following sections.

4.1.1 Process Overview

The ~~Hanford Tank Waste Treatment and Immobilization Plant~~ WTP will store and treat waste feed from the Hanford Site double-shell tank (DST) system in the pretreatment plant. The pretreatment plant will separate the waste into two feed streams for the ~~low-activity waste (LAW) and high-activity waste (HLW)~~ LAW and HLW melters. ~~The term LAW feed generally refers to the supernatant portion of the DST system waste.~~ Feed from the DST system is expected to be of four major waste feed types, or waste feed envelopes. These waste feed envelopes are described as follows:

- Envelope A. This waste feed envelope will contain cesium and technetium at concentrations high enough to warrant removal of these radionuclides during pretreatment, to ensure that the immobilized low-activity waste (ILAW) glass ~~waste~~ will meet applicable requirements.
- Envelope B. This waste feed envelope will contain higher concentrations of cesium than envelope A. Both cesium and technetium must be removed to comply with the ILAW specifications. This envelope may also contain concentrations of chlorine, chromium, fluorine, phosphates, and sulfates that are higher than those found in envelope A, which may limit the waste incorporation rate into the glass.

- Envelope C. This waste feed envelope will contain organic compounds containing complexed strontium and transuranics (TRU) that will require removal in a processing step unique to this waste envelope. As with envelopes A and B, cesium and technetium will also require removal in the pretreatment process to ensure that ILAW glass ~~waste~~ meets applicable requirements.
- Envelope D. HLW feed will be in the form of a slurry containing approximately 10 to 200 grams of unwashed solids per liter. The liquid fraction of the slurry will be ~~composed of residues from~~ separated from the solids and classified as envelope A, B, or C waste. ~~and t~~The solid fraction will be envelope D waste.

The WTP treatment processes are designed to immobilize the waste constituents in a glass matrix by vitrification and to treat the offgas from the processes to a level that protects human health and the environment.

Two similarly designed vitrification systems will be used in the WTP. One system will immobilize the pretreated LAW feed and the second will immobilize the pretreated HLW feed. The dangerous waste constituents in the melter feed will be destroyed, removed, or immobilized in a glass matrix through the vitrification process. The ILAW and immobilized high-level waste (IHLW) produced by the WTP will be in the form of glass packaged in stainless steel containers for ILAW and stainless steel canisters for IHLW and placed in permitted treatment, storage, and/or disposal (TSD) facilities.

Secondary waste streams (e.g., ~~radioactive and~~ dangerous and mixed solid waste, nonradioactive and nondangerous liquid effluents, ~~and radioactive~~ mixed waste and dangerous liquid effluents) will be characterized and recycled into the treatment process, transported to permitted treatment, storage, and/or disposal (TSD) facilities located on the Hanford Site, or transported off-site, as appropriate. Nonradioactive dangerous waste will also be generated by laboratory and maintenance activities. This waste will be managed at the WTP until it can be transferred to an off-site TSD unit.

There are four primary components of the ~~process at the~~ WTP: pretreatment, LAW vitrification, HLW vitrification, and the analytical laboratory. In addition, each of these waste treatment processes is supported by systems and utilities known as the balance of facilities ~~(BOF)~~. The following discussion presents an overview of these waste treatment processes and ~~BOF~~ balance of facilities systems at the WTP. Figure 4A-1 presents a simplified process flow ~~figure~~ diagram of the WTP treatment processes.

Pretreatment

The waste feed will be stored and subsequently treated in the pretreatment plant prior to vitrification. The processes in the pretreatment plant will condition the waste feed and remove cesium, technetium, strontium, TRU compounds, and entrained solids. The waste feed will also be processed through ultrafiltration to separate the solids.

There will be three types of waste management units in the pretreatment plant, as follows:

- Container storage areas
- Storage and treatment Tank systems
- Containment buildings
- Miscellaneous unit systems

The structure of the pretreatment plant is supported by a reinforced concrete foundation. The superstructure will be made of structural steelwork with a metal roof. Typically, the process cells within the pretreatment plant will be constructed of reinforced concrete. to protect plant operators from radiation. The cell floor and a portion of the cell walls will be lined with stainless steel to provide secondary containment for the process tanks and process piping. Furthur information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types is found in Dection 4.2.2. Secondary containment is provided as required for tank systems and miscellaneous unit systems managing dangerous or mixed waste. Secondary containment consists of either stainless steel liner or protective coating. Table 4-11 provides information on secondary containment. Figure 4A-2 and 4A-02A present simplified process flow diagrams of the pretreatment processes.

LAW Vitrification

The LAW vitrification plant will house the vitrification systems for production of the ILAW. Four Three types of waste management units will be located in the LAW vitrification plant, as follows:

- Container storage area
- Storage and treatment tTank systems
- Containment buildings
- Miscellaneous treatment unit (LAW melter) sub-systems and equipment

The LAW vitrification plant building will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure will be is made of reinforced concrete, and the superstructure will be made of reinforced concrete and structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation.

A protective coating will be applied to the concrete floor and walls of the LAW melter gallery. The floor and portions of the cell walls in process rooms that house mixed waste tanks will be lined with stainless steel. The melter pour caves will be completely lined with stainless steel. Secondary containment is provided as required for tank systems and miscellaneous unit sub-systems and equipment managing dangerous or mixed waste. Secondary containment consists of either stainless steel liner or protective coating.

~~Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2.~~ Table 4-11 provides information on secondary containment. Figure 4A-3 presents a simplified process flow diagram of the LAW vitrification treatment processes.

HLW Vitrification

The HLW vitrification plant will house the vitrification systems for producing IHLW. Four types of waste management units will be located in the HLW vitrification plant, as follows:

- Container storage areas
- T~~reatment tank~~ systems
- Containment buildings
- Miscellaneous treatment ~~unit~~ sub-systems and equipment

The HLW vitrification plant will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure ~~will be of~~ is reinforced concrete construction, and the superstructure will be made of structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation. ~~The cell and cave floors and a portion of the cell and cave walls will be lined with stainless steel to provide secondary containment for the process tanks.~~ Secondary containment is provided as required for tank systems and miscellaneous unit sub-systems and equipment managing dangerous or mixed waste. ~~Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2.~~ Secondary containment consists of either stainless steel liner or protective coating. Table 4-11 provides information on secondary containment. Figure 4A-4 presents a simplified process flow diagram of the HLW vitrification treatment processes.

Analytical Laboratory

The analytical laboratory will house the hot cells, laboratories, and systems for analyzing process samples and managing regulatory compliance samples. Two types of waste management units will be located in the analytical laboratory, as follows:

- Container storage areas
- Tank systems

The analytical laboratory will be constructed of reinforced concrete, structural steelwork, and a metal roof. The below-grade portions of the building structure will be constructed of reinforced concrete. The analytical laboratory structure will be supported by a reinforced concrete mat foundation. Secondary containment is provided as required for tank systems managing dangerous or mixed waste. Secondary containment consists of either stainless steel liner or protective coating. Table 4-11 provides information on secondary containment.

Balance of Facilities BOF
The BOF balance of facilities will includes, by definition, support systems and utilities required for the waste treatment processes within four main process areas the (pretreatment, LAW vitrification, HLW vitrification, and the analytical laboratory). The BOF balance of facilities support systems and utilities will include, but are not be limited to, heating and cooling, process steam, process water, chilled water, primary and secondary power supplies, and compressed air. The balance of facilities also includes the glass former reagent system (GFR) that supplies glass former reagents to the LAW and HLW vitrification facilities. Regulated waste management units within the balance of facilities BOF include the HLW out of service spent melter storage area the LAW out of service melter storage area facility and the nonradioactive dangerous waste storage area. and the central waste storage facility.

4.1.2 Pretreatment Plant

The pretreatment plant is designed to receive mixed waste from the DST system and separate and prepare the LAW and HLW feed streams for vitrification. The main functions performed at the pretreatment plant are as follows:

- Receive waste feeds from the Hanford Site DST system
- Separate cesium, strontium, technetium, and TRU radionuclides from the waste feeds
- Segregate solids into the HLW feed stream
- Concentrate the separated radionuclides for incorporation into the HLW feed stream
- Adjust the concentration of the waste for vitrification
- Collect and monitor liquid effluents
- Blend waste fractions to optimize treatment steps

The purpose of this section is to describe the major systems associated with the pretreatment plant. Descriptions of process systems, ventilation systems, and mechanical support systems associated with the pretreatment plant are provided in the following sections.

Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-2 presents the simplified flow of primary process system, and tThe following figures found in Appendix 4A and drawings, found in WA7890008967, *Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste* (DWP), Appendix Attachment 4A 51, Appendix 8, provide additional detail for the pretreatment plant:

- Simplified process flow figures for process information the WTP

- ~~Simplified p~~Process flow figures and drawings for process information
- Typical system figures depicting main features for each regulated system
- ~~Simplified g~~General arrangement figures and drawings showing locations of regulated equipment ~~and associated tanks~~
- Waste management area figures showing plant locations to be permitted
- ~~Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant~~

Vessels in black cells are designed for a 40-year life, and are of welded stainless steel construction. The black cells in the pretreatment facility are located adjacent to the hot cell. Hydraulic connections connect the black cells to each other and connect selected black cells to the hot cell. These hydraulic connections are used to cascade fluid flow between cells in the event that the black cell secondary containment hold-up volume is exceeded by the contents of a single leaking vessel in the black cell. As the liquid cascades from cell to cell it will reach the hot cell. The floors and lower portions of the black cells and hot cell walls are partially lined with stainless steel for secondary containment. This secondary containment will have a gradient designed to channel liquid to a low-point sump within each black cell. Black cells and hot cells will be equipped with an instrumented sump or sumps for detecting loss of vessel or piping integrity. Liquids are removed from the black cell sumps by steam ejectors.

The radiation monitor and valves with potential exposure to elevated radiation are contained within a shielded bulge attached to the outside wall of the black cell. The bulge provides secondary containment and is equipped with decontamination sprays, liquid level instrumentation, a drain to the Ultimate Overflow Vessel (PWD-VSL-00033).

Liquid level in the vessels will be monitored and maintained within low and high operating limits. Regulated WTP plant tank systems processes and leak detection systems instruments and parameters will be provided in Table III.10.E.E. Regulated miscellaneous treatment systems process and leak detection systems instruments and parameters will be provided in Table III.10.G.C.

At times, internal decontamination of vessels may be required. The primary permanent process vessels are fitted with wash rings for decontamination by flushing. Wash systems will be able to introduce water, caustic solution, or acid. The stainless steel lined floor provides secondary containment.

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.

- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control, system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of liquid mixed or dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.

- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.

- Loss of mixing function: Tank systems are instrumented (air pressure/flow indication) to prevent hydrogen accumulation and solids settling. A forced air in-bleed is provided to dilute hydrogen generated through radiolysis.

- Loss of process function: System vessels using reverse flow diverters incorporated dual reverse flow diverter system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.
- Overheating: Temperature regulation with chilled water is provided for those plant items where heat may be generated due to radiolysis. Chilled water lines will be monitored for contamination.
- Overpressurization: Relief is provided by use of rupture disks.
- Vacuum in vessels: Relief is provided through the PVP system during transfer of waste out of vessels.
- Loss of air flow: The ventilation system creates a pressure gradient which causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential.

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment systems in some cases. Additional information may be found in the system logic descriptions located in DWP Attachment 51, Appendix 8.13.

4.1.2.1 Waste Feed Receipt Process (FRP) System

Figure 4A-5 presents a simplified process flow diagram of the waste feed receipt process system (FRP). ~~The FRP receives waste from the DST system and pretreatment waste processing, facilitates sampling of the waste, provides lag storage, and transfers the waste~~

feed for subsequent treatment within the pretreatment plant. The primary function of the FRP is to receive batch transfers of waste feed from the Double Shell Tank (DST) system, and to store the waste pending processing through pretreatment.

The main components of the FRP system are:

- Waste transfer lines
- Waste Feed Receipt Vessels (FRP-VSL-00002A/B/C/D)
- Vessel inlet and outlet valve headers
- Pumps, piping, and instrumentation for waste transfers
- Waste sampling equipment
- Four waste receipt vessels (V11020A, V11020B, V11020C, and V11020D)
- A cell containing the receipt vessels, including containment and ventilation features
- Waste sampling equipment
- Receipt tank mixing and transfer components
- Piping associated with waste receipts and transfers

Each Waste Feed Receipt Vessel (FRP-VSL-00002A/B/C/D) has a working volume of approximately 375,800 gallons, for a total working volume of approximately 1.5 million gallons. Waste feed will normally be transferred from the DST system in batches up to 1 million gallons into three of the four Waste Feed Receipt Vessels. The fourth vessel containing waste feed from the preceding transfer is used to sustain production while the current batch transfer is being mixed and sampled to verify waste characteristics.

The Waste Feed Receipt Vessels can also receive excess recycles or excess concentrate from the Waste Feed Evaporation Process (FEP) System and off-specification treated LAW from the treated LAW Concentrate Storage Process (TCP)System. The waste feed stored in the Waste Feed Receipt Vessels is batch-transferred forward for processing to either the FEP system or to the Ultrafiltration Process (UFP)System. The FRP system also has the capability to return stored waste to the DST system.

Waste feed is received from the DST system through the inner pipe of any one of three co-axial transfer lines. The inlet valve header routes the waste to the Waste Feed Receipt Vessels. The inlet and outlet valve headers and pumps are used in combination to facilitate the transfer of waste from one Waste Feed Receipt Vessel to another, forward transfer of waste to the pretreatment process, or the return of waste to the DST system using the transfer lines.

FRP system design features include:

- Capability to pressure-test both the inner and outer transfer lines for integrity

- Transfer line leak detection system for integrity indication during transfer
- Transfer line flushing and draining capability
- Instrumentation for monitoring vessel liquid level
- Vessel vent to the Pretreatment Vessel Vent Process (PVP)System
- Forced air purge and passive air purge of the vessel vapor space for mitigation of hydrogen gas buildup
- Internal pulse jet mixers (PJMs) for solids suspension and slurry mixing
- Remote sampling capability off the discharge of the transfer pump
- Vessel spray rings for vessel decontamination

~~Waste is received from the DST system through the inner pipe of any one of three co-axial transfer pipes. These pipes, equipped with leak detection systems within the outer pipe, allow receipt of the waste into the four receipt vessels. Piping is also available to allow transfer of waste from one receipt vessel to another, as well as allowing storage and return of treated waste from within the pretreatment plant.~~

~~The waste receipt vessels are of stainless steel construction. Each tank is equipped with pulsejet mixers to mix the vessel contents and suspend solids. Reverse flow diverters are provided for each vessel to transfer the waste, and each is equipped with an automated sampling system to allow confirmation of the individual tank waste characteristics. Waste receipt vessels are vented to the Pretreatment Vessel Vent Process System (PVP).~~

~~The cell containing the receipt vessels is partially lined with stainless steel to form a secondary containment. This secondary containment will accommodate up to 100 % of the volume of the largest vessel in the cell and will have a gradient (minimum 1%) designed to channel fluids to a sump. This sump is equipped with liquid level detection and alarm capabilities and an ejector to allow transfer of waste detected. Cell and vessel wash capabilities are installed for decontamination activities. The receipt vessels have internal wash rings for this purpose.~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the FRP to indicate or prevent the following conditions:~~

- ~~Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)~~
- ~~Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)~~
- ~~Loss of system integrity (vessel and sump level indications)~~
- ~~Loss of mixing function (air pressure/flow indication)~~
- ~~Vessel overflow (transfers from DST and into vessels not permitted if level is high because it may cause overflow)~~

- Inadvertent transfer (WTP permissive signals to transfer pumps operated by the tank farm contractor)
- High temperature or level in the system that could compromise system integrity (instruments, alarms)
- Inaccurate tank level (density compensator to adjust waste level indicated to actual level)

4.1.2.2 Waste Feed Evaporation Process (FEP) System

Figure 4A-6 presents a simplified process flow diagram of the Waste Feed Evaporation Process (FEP)System. The primary process function of the FEP tanks and miscellaneous unit system is to concentrate waste streams from: are to receive waste from FRP and miscellaneous recycle streams, to evaporate a portion of the feed (reducing the volume and increasing the sodium concentration), to transfer waste to the Ultrafiltration Process System (UFP), to condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD), and to vent non-condensable gases to the PVP for treatment.

The FEP is composed of two evaporator trains arranged in parallel. The evaporator trains can be operated independently or at the same time depending on the evaporation needs.

- the FRP system,
- the HLW Lag Storage and Feed Blending Process (HLP)System,
- the Plant Wash and Disposal Process (PWD)System and
- the Spent Resin Collection and Dewatering Process (RDP)System.

The main components of the FEP tank and miscellaneous unit system are as follows:

The main components of the FEP

- Two evaporator feed vessels (V11001A and V11001/B)
- Two evaporator trains, each composed of a waste feed evaporator separator vessel (V11002A and V11002B) with demisters, a reboiler, a recirculation pump, and overhead condensers
- Single evaporator condensate pot (V11005)
- Pumps and associated piping for transfer of waste

The waste feed evaporators are forced-circulation units operating under vacuum to reduce the operating temperature. Each evaporator feed vessel has a pulsejet agitation system to provide mixing and to prevent settling of solids. The waste feed from the feed vessels is pumped continuously to the evaporator.

A pump maintains a high flow rate around the evaporation system. The pump transfers the waste through the reboiler and back into the waste feed evaporator separator vessel.

The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.

As the liquid travels through the reboiler, the hydrostatic head diminishes and flash evaporation occurs as the flow enters the waste feed evaporator separator vessel. The liquid continues to flash and the vapor and liquid streams are separated. The liquid stream circulates in this closed loop and becomes more concentrated, while the vapor stream passes to the evaporator overheads system. The concentrate off-take comes from a pump and is discharged to evaporator concentrate buffer vessels (V12010A and V12010B) in the UFP.

The vapor stream from the evaporator is condensed in the overhead system which contains a three-stage condenser system consisting of a primary condenser, an intercondenser, and an aftercondenser. The non-condensable from the after-condenserpass through the demister, which removes entrained droplets. The non-condensable are then routed to the PVP for treatment. The condensed vapor from the overhead system is collected in a condensate pot and then transferred to process condensate vessels in the Radioactive Liquid Waste Disposal System (RLD) for discharge to the Liquid Effluent Retention Facility (LERF) and/or the Effluent Treatment Facility (ETF). If the condensate does not meet the LERF/ETF waste acceptance criteria, the condensate from the system is recycled back through the waste feed evaporation system.

Instrumentation, alarms, controls, and interlocks will be provided for the FEP to indicate or prevent the following conditions:

- Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)
- Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)
- Loss of system integrity (vessel and sump level indications)
- Loss of mixing function (air pressure/flow indication)
- High temperature or high level in the system that could compromise system integrity (instruments, alarms)

Tank system

- Waste Feed Evaporator Feed Vessels
- LAW Feed Evaporator Condensate Vessel
- Vessel outlet valve headers
- Pumps, piping, and instrumentation for waste transfers

Miscellaneous Unit systems

- Waste Feed Evaporator Separator Vessels
- Primary Condensers
- Inter-Condensers (FEP-COND-00002A/B)
- After-Condensers (FEP-COND-00003A/B)
- Reboilers (FEP-RBLR-00001A/B)
- Pumps

The Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) will deliver concentrate to the Ultrafiltration Process (UFP) System. Overhead vapors and noncondensables from the Waste Feed Evaporator Separator Vessels are routed to the Primary Condensers (FEP-COND-00001A/B). Process condensate from the Primary Condensers and steam condensate from the vacuum system are collected in the Waste Feed Evaporator Condensate Vessel (FEP-VSL-00005) and discharged to the Radioactive Liquid Waste Disposal Process(RLD) System. The noncondensables from the vacuum system are discharged to the PVP system.

During off-normal conditions, excess dilute recycles to the FEP Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B), or excess concentrate from the FEP Waste Feed Evaporator Separator Vessels can be routed to the FRP system for interim storage. Fluids generated from solids washing in the UFP system that are collected in the HLP system and are too dilute for feed to HLW vitrification can also be concentrated in the FEP system.

The FEP system includes two Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B) for managing feed makeup from multiple sources. One Waste Feed Evaporator Feed Vessel will be in a makeup mode while the alternate vessel is feeding the evaporator trains.

The design features of the FEP evaporator feed system include:

- Internal pulse jet mixers for solids suspension
- Instrumentation for monitoring vessel liquid level
- Vessel vent to the PVP system
- Forced air purge and passive air purge of the vessel vapor space for mitigation of hydrogen gas buildup
- Pump and line flushing capability
- Transfer flow rate indication and transfer volume totalizer
- Remote sampling capability off the discharge of the transfer pumps
- Vessel spray rings for vessel decontamination

The FEP waste feed evaporator trains can be operated independently or at the same time depending on the evaporation needs. The Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) are forced-circulation units operating under vacuum to reduce the operating temperature. Recirculation pumps maintain a high flow rate from the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) to the Reboilers (FEP-RBLR-00001A/B). Pumps maintain a high flow rate around the evaporation system. The pumps transfer the waste through the Reboilers and back into the Waste Feed Evaporator Separator Vessels. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head (submergence) to increase the boiling point above the temperature of the liquor in the Reboiler tubes.

As the liquid travels out of the Reboilers (FEP-RBLR-00001A/B), the hydrostatic head diminishes and flash evaporation occurs as the flow enters the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B). The liquid continues to flash and the vapor and liquid streams are separated (liquid-vapor disengagement). The liquid stream circulates in this loop and becomes more concentrated, while the vapor stream passes through a demisting section to the evaporator condensers. A portion of the concentrate is also pumped from the bottom of the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) at the controlled liquid density and is discharged to Ultrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) in the UFP system, or is recycled to the FRP system.

The vapor stream exiting the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) is condensed in a three-stage condenser system consisting of Primary Condensers (FEP-COND-00001A/B), Inter-Condensers (FEP-COND-00002A/B), and After-Condensers (FEP-COND-00003A/B). The noncondensables exiting the After-Condenser are routed to the PVP system for treatment.

Design features of the evaporator trains include:

- Operating pressure indication and control
- Differential pressure indication across the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) demister section
- Water sprays to the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) demister section
- Process condensate radiation monitoring and recycle capability
- Low-pressure steam supply for heating the Reboilers (FEP-RBLR-00001A/B)
- Reboilers (FEP-RBLR-00001A/B) tube leak detection and diversion capability
- Reboilers (FEP-RBLR-00001A/B) steam condensate collection
- Instrumentation for monitoring and control of vessel liquid level

- Forced air purge of the vessel vapor space for mitigation of hydrogen gas buildup (passive venting of purge air via the downstream vessels connected to the vent header)
- Capability to drain, flush, and chemically clean the system

The condensed vapor from the FEP condensers is collected in the Waste Feed Evaporator Condensate Vessel (FEP-VSL-00005). One condensate vessel is used to collect condensate from both evaporator trains. A small fraction of the total condensate is recycled to the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) demister water sprays. The balance of the condensate is transferred to the RLD system. Off-specification condensate is recycled to the Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B).

Design features include:

- Instrumentation for monitoring and control of vessel liquid level
- Vessel vent to the PVP system
- Outlet valve header
- Remote sampling capability off the discharge of the transfer pumps
- Dip legs in the vessel that maintain a liquid seal (pressure boundary) between the vessel and the condensers
- Makeup recycle water as required for startup

4.1.2.3 Ultrafiltration Process (UFP) System

Figure 4A-7 presents a simplified process flow diagram of the Ultrafiltration Process (UFP) System. The UFP tank system separates the waste feed from the HLW Lag Storage and Blending Process and the Waste Feed Receipt Process Systems and/or the Waste Feed Evaporation Process System into a high solids stream, referred to as the HLW feed stream, and a relatively solids free stream, referred to as the LAW feed stream. In the UFP system, the separated solids may undergo additional treatment (washing and/or leaching operations) to reduce the quantity of IHLW produced. In addition, the LAW feed stream may require Sr/TRU removal (Envelope C only). This operation will be performed in the UFP system prior to solids separation.

The main components of the UFP tank system are:

- Ultrafiltration Feed Preparation Vessels UFP-VSL-00001A/B)
- Ultrafiltration Feed Vessels (UFP-VSL-00002A/B)
- Two ultrafilter trains, each containing three individual Ultrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B)

- Associated ultrafilter backpulsing equipment
- Ultrafilter Permeate Vessels (UFP-VSL-00062A/B/C)
- Pumps, piping, and instrumentation for waste transfers

Ultrafiltration is a filtration process in which the waste stream is processed axially through the Ultrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B), which are long bundles of permeable tubes. Solids-free liquids pass radially through the permeable ultrafilter tubes surface while the concentration of the solids in the recirculating stream continuously increases. The resulting solids slurry may need treatment such as caustic leaching and/or water washing to reduce the quantity of IHLW glass produced.

Waste is received from the HLP, FRP, and/or the FEP systems into the Ultrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) of the UFP system. The waste may be sampled here to determine the ultrafiltration parameters. For envelope C feeds, chemicals are added to the Ultrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) to precipitate strontium and TRU elements contained in the incoming waste stream prior to solids concentration by ultrafiltration. Heat (if required) and agitation can be applied to ensure that the precipitation process is completed.

The Ultrafiltration Feed Preparation Vessels (UFP-VSL-00001A/B) feed the Ultrafiltration Feed Vessels (UFP-VSL-00002A/B), which feed the ultrafilters themselves. During the initial solids concentration, the solids-free stream generated by ultrafiltration is designated as the LAW feed stream, which is then routed to one of the three Ultrafilter Permeate Vessels (UFP-VSL-00062A/B/C). Here, the permeate is sampled for solids breakthrough (turbidity) prior to further processing, which includes cesium and technetium removal and additional evaporation prior to LAW vitrification.

The resulting concentrated slurry may then be washed in the Ultrafiltration Feed Vessels (UFP-VSL-00002A/B) with process water or caustic leached to remove interstitial liquid, soluble salts, and/or HLW glass-limiting compounds and further processed through the Ultrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B). The final concentrated HLW feed stream is transferred to the HLW Lag Storage Vessels (HLP-VSL-00027A/B) of the HLP system and then on to the HLW vitrification process. Permeate from solids treatment is also collected in Ultrafilter Permeate Vessels (UFP-VSL-00062A/B/C), but this stream is normally routed to the plant wash and disposal process system (PWD) for recycle.

During waste processing, the permeability of the Ultrafilters (UFP-FILT-00001A/1B/2A/2B/3A/3B) is reduced over time. Re-establishing the ultrafilters' permeability can be accomplished using one of two different methods: 1) backpulsing with filter permeate or 2) cleaning utilizing nitric acid or caustic. Backpulsing may be utilized while the filter is in operation, but cleaning requires the filters to be out of operation. Filter performance will be monitored to determine when cleaning is required.

The primary design features of the UFP system are:

- Pulse jet mixers in the Ultrafiltration Feed Preparation Vessels, the Ultrafiltration Feed Vessels, and in the Ultrafilter Permeate Vessels
- Cooling jackets on the Ultrafiltration Feed Preparation Vessels and on the Ultrafiltration Feed Vessels
- Passive vessel overflow routes for the Ultrafiltration Feed Preparation Vessels, the Ultrafiltration Feed Vessels, and in the Ultrafilter Permeate Vessels to the Ultimate Overflow Vessel (PWD-VSL-00033)
- Heating ejectors for the Ultrafiltration Feed Preparation Vessels and the Ultrafiltration Feed Vessels
- Emptying ejectors for the Ultrafiltration Feed Preparation Vessels
- Sampling capabilities for the Ultrafiltration Feed Preparation Vessels, the Ultrafiltration Feed Vessels, and in the Ultrafilter Permeate Vessels
- Vessel wash rings for the Ultrafiltration Feed Preparation Vessels , the Ultrafiltration Feed Vessels , and in the Ultrafilter Permeate Vessels Ventilation (both passive and forced) for the Ultrafiltration Feed Preparation Vessels, the Ultrafiltration Feed Vessels , and in the Ultrafilter Permeate Vessels

~~The UFP separates the concentrated waste feed from the evaporator system into a high solids stream, referred to as the HLW feed stream and a solids free stream, the LAW feed stream. The separated solids may undergo additional treatment (washing and/or leaching operation). These operations will be performed in the UFP system. In addition, the LAW feed stream may require Sr/TRU removable. This operation will also be performed in the UFP system prior to solids separation.~~

~~The main components of the UFP system are:~~

- ~~Two evaporator concentrate buffer vessels (V12010A and V12010B) each equipped with pulse jet mixers and cooling jackets~~
- ~~Two concentrate transfer pumps~~
- ~~Two ultrafiltration feed vessels (V12011A and V12011B) each equipped with pulse jet mixers and cooling jackets~~
- ~~Two ultrafilter feed pumps~~
- ~~Two ultrafilter trains, each containing three individual ultrafilter units [(G12002A, G12003A, G12004A) and (G12002B, G12003B, G12004B)]~~
- ~~Associated ultrafilter backpulsing equipment~~

~~Three LAW permeate hold vessels (V12015A, V12015B, V12015C)),forced),~~
~~Ultrafiltration is a filtration process in which the waste stream is processed axially through the ultrafilters, which are long bundles of permeable tubes. Solids-free liquids~~

pass radically through the permeable ultrafilter tubes surface while the concentration of the solids in the recirculating stream continuously increases. The resulting solids slurry may need treatment such as caustic leaching and/or water washing to reduce interstitial liquid buildup to minimize the quantity of glass produced.

Waste is received from the FEP into the evaporator concentrate buffer vessels (V12010A and V12010B) of the UFP system. The waste may be sampled here to determine the Ultrafiltration parameters. For envelope C feeds, chemicals are added to the evaporator concentrate buffer vesselto precipitate strontium and TRU elements contained in the incoming waste stream prior to solids concentration by ultrafiltration. Heat (if required) and agitation are applied to ensure that the precipitation process is completed.

The solids-free stream generated by Ultrafiltration is designated as the LAW feed stream, which is then routed to one of the three LAW permeate hold vessels (V12015A, V12015 B, or V12015C). Here, the permeate is sampled for solids prior to further processing, which includes cesium and technetium removal and additional evaporation prior to LAW vitrification.

The concentrated slurry may then be washedwith process water or caustic leached to remove interstitial liquid, soluble salts, and/or HLW glass limiting compounds and further processed through the ultrafilter. The concentrated solids stream, or HLW feed stream, is transferred to the lag storage vessels (V12001D and V12001E) of the HLW Lag Storage and Feed Blending System (HLP) and then on to the HLW vitrification process. The treated solids may also be returned to the DST system via the FRP.

During waste processing, the permeability of the ultrafilters is reduced over time. Re-establishing the ultrafilters' permeability can be accomplished using one of two different methods which include backpulsing with filter permeate or cleaning utilizing nitric acid or caustic. Backpulsing may be utilized while the filter is in operation, but cleaning requires the filters to be out of operation. Filter performance will be monitored to determine when cleaning is required.

Instrumentation, alarms, controls, and interlocks will be provided for the UFP system as follows:

- Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing
- Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels
- Level instrumentation and overflow piping with alarm set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system

- ~~In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell) which will have an engineered route back into the process~~
- ~~Leaks will be detected via sump instrumentation~~

4.1.2.4 HLW Lag Storage and Feed Blending Process (HLP) System

Figure 4A-8 presents a simplified process flow diagram of the HLW Lag Storage and Feed Blending Process (HLP) System. The HLP system receives the Envelope D slurry from the DST system and the treated HLW slurry from the UFP system. This system provides receipt, storage, and transfer capability for the Envelope D feed, provides lag storage for the treated high-level waste solids slurry, and blends HLW vitrification feed prior to transfer and subsequent processing in the HLW vitrification plant. The system also provides for blending of separated cesium and technetium from the Cesium Nitric Acid Recovery Process (CNP) System with the HLW feed stream prior to transfer to the HLW vitrification plant.

The main components of the HLP tank system are:

- HLW Feed Receipt Vessel (HLP-VSL-00022)
- HLW Lag Storage Vessels (HLP-VSL-00027A/B)
- HLW Feed Blending Vessel (HLP-VSL-00028)
- Pumps, piping, and instrumentation for waste transfers

HLW feed from the DST system is received into the HLW Feed Receipt Vessel (HLP-VSL-00022). The waste stored in this vessel is sampled and sent to either the UFP system, the Waste Feed Evaporation Process (FEP), System or the Waste Feed Receipt Process (FRP) System for processing.

Treated high solids waste (HLW feed stream) received from the UFP system is stored in the HLW Lag Storage Vessels. The waste stored in these vessels is sampled to determine blending and to comply with vitrification parameters of IHLW. In the HLP system, strontium/TRU precipitate slurry is segregated from the other HLW slurry and then blended in the HLW Feed Blending Vessel. The HLW Lag Storage Vessels are back up vessels to the HLW Feed Blending Vessel (HLP-VSL-00028).

The HLW feed stream is routed from the HLW Lag Storage Vessels to the HLW Feed Blending Vessel. The HLW Feed Blending Vessel also receives a cesium and technetium containing stream that has been recovered from the LAW feed stream in the waste treatment process. The cesium and technetium addition rates to the HLW feed stream are controlled based upon the results of the sampling previously conducted in the HLW Lag Storage Vessels (HLP-VSL-00027A/B). The final blended HLW feed stream is then transferred to the HLW vitrification plant for final treatment and immobilization. Alternatively, the blended HLW feed stream may be returned to the DST system.

The primary design features of the HLP system are:

- Internal pulse jet mixers in the HLW Feed Receipt Vessel the HLW Lag Storage Vessels, and the HLW Feed Blending Vessel for solids suspension
- Cooling jackets on the HLW Feed Receipt Vessel , the HLW Lag Storage Vessels , and the HLW Feed Blending Vessel
- Passive vessel overflow routes for the HLW Feed Receipt Vessel , the HLW Lag Storage Vessels , and the HLW Feed Blending Vessel to the Ultimate Overflow Vessel (PWD-VSL-00033)
- Sampling capabilities for the HLW Feed Receipt Vessel , the HLW Lag Storage Vessels , and the HLW Feed Blending Vessel
- Vessel wash rings for the HLW Feed Receipt Vessel , the HLW Lag Storage Vessels , and the HLW Feed Blending Vessel
- Ventilation (both passive and forced) for the HLW Feed Receipt Vessel , the HLW Lag Storage Vessels , and the HLW Feed Blending Vessel

The HLW HLP receives the HLW feed stream from the UFP. It provides lag storage for the high solids slurry and blends HLW vitrification feed prior to transfer and subsequent processing in the HLW vitrification plant. The system also provides for blending of cesium and technetium recovered from the LAW treatment process into the HLW feed stream prior to transfer to the HLW vitrification plant.

The main components of the HLP are:

- Strontium/TRU lag storage vessels (V12001A and V12001C)
- Lag storage vessels (V12001D and V12001E)
- HLW feed blending vessel (V12007)
- Associated pumps and piping

High solids waste, designated as the HLW feed stream, is received from UFP and stored in the lag storage vessels. The waste stored in these vessels is sampled to determine blending and to comply with vitrification parameters of IHLW. In the HLP, strontium/ TRU precipitate slurry is segregated from the other HLW slurry, and stored in the strontium/TRU lag storage vessels.

The HLW feed stream is routed from the lag storage tanks to the HLW feed blending vessel. The HLW feed blending vessel also receives cesium and technetium that has been recovered from the LAW feed stream in the waste treatment process. The cesium and technetium addition rates to the HLW feed stream are controlled based upon the results of the sampling previously conducted in the HLW lag storage vessels. The final blended HLW feed stream is then transferred to the HLW vitrification plant for final treatment and immobilization. Alternatively, the blended HLW feed stream may be returned to the DST system.

Instrumentation, alarms, controls, and interlocks will be provided for the HLP as follows:

- Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing
- Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels
- Level instrumentation and overflow piping with alarm/trip set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system
- In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell) which will have an engineered route back into the process
- Leaks will be detected via sump instrumentation located in the cell sump

4.1.2.5 Cesium Ion Exchange Process (CXP) System

Figure 4A-9 presents a simplified process flow diagram of the Cesium Ion Exchange Process (CXP) System. The primary function of the CXP tank system is to remove cesium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts cesium. After caustic and water rinses to remove residual LAW feed, elution of the cesium-loaded resin is accomplished using dilute nitric acid. The cesium-loaded nitric acid is then routed to the Cesium Nitric Acid Recovery Process (CNP) system with the cesium ultimately processed in the HLW melter.

The main components of the CXP tank system are:

- Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4)
- Cesium Ion Exchange Feed Vessel (CXP-VSL-00001)
- Cesium Ion Exchange Caustic Rinse Collection Vessel (CXP-VSL-00004)
- Cesium Reagent Vessel (CXP-VSL-00005)
- Cesium Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C)
- Pumps, piping, and instrumentation for waste transfers

The Cesium Ion Exchange Caustic Rinse Collection Vessel (CXP-VSL-00004) is used for receipt (from Ion Exchange Columns-CXP-IXC-00001/2/3/4) and transfer (to Cs IX Reagent Vessel-CXP-VSL-00005) of the caustic rinse. Transfer of the caustic rinse is accomplished using reverse flow diverters. The Cesium Reagent Vessel (CXP-VSL-00005) is used to supply demineralized water and caustic solutions, as well as to supply nitric acid for elution.

The Cesium Ion Exchange Feed Vessel (CXP-VSL-00001) receives LAW feed from the UFP system and provides feed buffer capacity to allow continuous operation of the ion exchange system. The CXP uses four Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4). At any given time, three of the columns are used in series to remove cesium from the LAW feed stream. The three columns are termed lead, lag, and polishing columns, depending on their position in the train. The fourth column is eluted and regenerated, and is then placed in a standby mode until the lead column reaches the desired cesium loading. At this point, the lead column is rotated out for elution, the lag column becomes the lead, the polishing column becomes the lag, and the standby column is rotated into the polishing position.

The concentration of cesium in the feed stream is monitored prior to and following each Cesium Ion Exchange Column (CXP-IXC-00001/2/3/4). When cesium is detected above an established set point following an ion exchange column, the lead column is taken out of the loading cycle, eluted, and the resin bed regenerated while the other columns are placed into the loading cycle.

Elution is part of a resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed stream in the column by rinsing with dilute caustic solution to prevent the potential of precipitating aluminum hydroxide from the LAW feed stream at low pH values. This caustic rinse is provided from the Cesium Ion Exchange Reagent Vessel (CXP-VSL-00005)
- Displacement of residual dilute caustic solution from the column with demineralized water to prevent an acid-base reaction during elution
- Elution of cesium ions with dilute nitric acid
- Displacement of residual acid from the column with demineralized water to prevent an acid-base reaction with the caustic solution
- Regeneration of the resin bed with caustic solution

After a number of loading and regeneration cycles, the resin is expected to lose performance and is termed "spent". The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled Ion Exchange resin flush solution and flushed out of the column into the Spent Resin Collection and Dewatering Process (RDP) System for resin disposal. A slurry of fresh resin is prepared in the Cesium Resin Addition Process (CRP) System and then added to the column as an ion exchange column bed replacement.

A standby elution system is provided by three tanks; one containing nitric acid, another containing demineralized water, and a third tank containing sodium hydroxide. Each tank has a volume sufficient to fully elute one fully loaded column, and one partially loaded column. The tanks are located at an elevation sufficiently high above the Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) to provide enough hydrostatic head to induce flow through the Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) and associated piping to the destination vessel.

Following cesium ion exchange, the treated LAW feed is transferred to the Cesium Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) for further treatment in the Treated LAW Evaporation Process (TLP) System and the Treated LAW Concentrate Storage Process (TCP) System.

The primary design features of the CXP system are:

- Instrumentation for monitoring and control of vessel liquid level.
- Pulse jet mixers in the Cs IX Caustic Rinse Collection Vessel (CXP-VSL-00004) and the Cesium Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B).
- Passive vessel overflow routes from the Cs Ion Exchange Feed Vessel (CXP-VSL-00001), the Cs IX Caustic Rinse Vessel, the Cs IX Reagent Vessel (CXP-VSL-00005) and the Cesium Ion Exchange Treated LAW Collection Vessels.
- Remote sampling capabilities on the discharge of transfer pumps.
- Connection of the vessel vapor space to the Pretreatment Vessel Vent Process (PVP) System.

~~The primary function of the CXP is to remove cesium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts cesium. Elution of the cesium-loaded resin is accomplished using dilute nitric acid. The cesium-loaded nitric acid is then routed to the nitric acid recovery process system (CNP) with the cesium ultimately processed in the HLW melter.~~

~~The main components of the CXP are:~~

- ~~Four cesium ion exchange columns (C13001, C13002, C13003, and C13004) for cesium removal~~
- ~~LAW feed vessel (V13001)~~
- ~~Caustic rinse collection vessel (V13008)~~
- ~~Two treated LAW transfer pumps~~

~~Other equipment includes a vessel for receipt and transfer of the caustic rinse. Transfer of the caustic rinse is accomplished using reverse flow diverters. In addition, the cesium reagent vessel is used to supply dematerialized water and caustic solutions, as well as to supply reagents (nitric acid, dematerialized water, and caustic solution) for elution.~~

The CXP uses four columns operating in series. At any given time, only three of the ion exchange columns are operating in the loading cycle, removing cesium from the LAW feed stream, for purposes of column loading efficiency. The order of the columns may be rotated in series so that any of the columns may be in the lead position. The remaining ion exchange column is being eluted and regenerated, having its spent resin replaced, or is regenerated and in a standby mode. After a lead column is eluted, it typically becomes a lag column in the next loading cycle.

The concentration of cesium in the feed stream is monitored prior to and following each ion exchange column. When cesium is detected above an established set point following an ion exchange column, that column is taken out of the loading cycle, eluted, and the resin bed regenerated while the other columns are placed into the loading cycle.

Elution is part of a resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed stream in the column by rinsing with dilute caustic solution to prevent the potential of precipitating aluminum hydroxide from the LAW feed stream at low pH values. This caustic rinse is collected in the caustic rinse collection vessel.
- Displacement of residual dilute caustic solution from the column with dematerialized water to prevent an acid-base reaction during elution.
- Elution of cesium ions with dilute nitric acid.
- Displacement of residual acid from the column with dematerialized water to prevent an acid-base reaction with the caustic rinse.
- Regeneration of the resin with caustic solution.

After a number of loading and regeneration cycles, the resin is expected to lose performance and is termed "spent". The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column into the spent resin collection and dewatering process (RDP) system for resin disposal. A slurry of fresh resin is prepared in the cesium resin addition process (CRP) system and then added to the column as an ion exchange column bed replacement.

A standby elution system is provided by three tanks; one containing nitric acid, another containing dematerialized water, and a third tank containing sodium hydroxide. Each tank has a volume sufficient to fully elute one fully loaded column, and one partially loaded column. The tanks are located at an elevation sufficiently high above the ion exchange columns to provide enough hydrostatic head to flow through the reagent vessel, pumps, one of the ion exchange columns, and associated piping.

Instrumentation, alarms, controls, and interlocks will be provided for the CXP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, and high-level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Overheating: Temperature regulation is provided to the ion exchange columns by a chilled-water supply that operates continuously. Temperature indication is provided on each ion exchange column, and chilled water return lines will be monitored for flow.
- Leakage of process liquids into chilled water: Chilled water return lines will be monitored for contamination.
- Overpressurization: Pressure relief for each ion exchange column is provided by a relief valve that discharges to a piping header that is vented to the LAW feed vessel.
- Loss of containment: Vessels are protected against containment loss by liquid level indication, high-level interlocks to shut off feed sources, and PCS control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel, and sump level instrumentation detects liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverter system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.
- Column hydrogen venting: Each column is provided with a separate vessel to continuously collect and vent hydrogen generated in the columns. Hydrogen is vented through a restriction orifice to the vessel vent system. Air is continually purged into the vapor space in the hydrogen venting vessel to ensure that the concentration of hydrogen is maintained in an acceptable range.

4.1.2.6 Cesium Nitric Acid Recovery Process (CNP) System

Figure 4A-10 presents a simplified process flow diagram of the Cesium Nitric Acid Recovery Process (CNP) System. The CNP system recovers nitric acid that was previously used for elution of the cesium ion exchange resin bed so it may be used as eluant. In addition, this system concentrates and transfers the cesium eluted from the ion exchange system to HLP-VSL-00028/27B for incorporation into the HLW melter feeds.

The CNP system is composed of tanks and miscellaneous unit systems, and consists of the following equipment.

Tank System

- Eluate Contingency Storage Vessel (CNP-VSL-00003)
- Cesium Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004)
- Cesium Evaporator Eluant Lute Pot (CNP-VSL-00001)
- Pumps, piping, and instrumentation for waste transfers

Miscellaneous Unit Systems

- Cesium Evaporator Separator Vessel (CNP-EVAP-00001)
- Cesium Evaporator Concentrate Reboiler (CNP-HX-00001)
- Cesium Evaporator Nitric Acid Rectifier (CNP-DISTC-00001)
- Cesium Evaporator Primary Condenser (CNP-HX-00002)
- Cesium Evaporator Secondary Condenser (CNP-HX-00003)
- Cesium Evaporator After-Condenser (CNP-HX-00004)
- High Efficiency Particulate Air Filter (CNP-HEPA-00006)
- Pumps, piping, and instrumentation for waste transfers

During the process of regenerating the cesium ion exchange resin beds, eluate composed of cesium-bearing nitric acid will be fed to the Cesium Evaporator Separator Vessel (CNP-EVAP-00001) operating under reduced pressure. A closed-loop circulation stream is fed from the evaporator to the steam-heated Cesium Evaporator Concentrate Reboiler (CNP-HX-00001) and back to the Cesium Evaporator Separator Vessel (CNP-EVAP-00001).

Vapor from the Cesium Evaporator Separator Vessel (CNP-EVAP-00001), composed primarily of water and nitric acid, is sent to the Cesium Evaporator Nitric Acid Rectifier (CNP-DISTC-00001) where the nitric acid is recovered for reuse as eluant. Recovered nitric acid is collected in the Cesium Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) for reuse in the elution of cesium ion exchange column resin beds. Condensed water vapor is recovered from the Cesium Evaporator Primary Condenser (CNP-HX-00002), Cesium Evaporator Secondary Condenser (CNP-HX-00003), and Cesium Evaporator After-Condenser (CNP-HX-00004), and sent to the PWD system. These condensers are water-cooled shell-and-tube heat exchangers. Uncondensed vapors exiting from the after-condenser are routed to the PVP system for further treatment.

The cesium concentrated in the evaporator is routed to the HLW Feed Blending Vessel (HLP-VSL-00028) for blending and incorporation into the HLW melter feed streams. This cesium concentrate may also be stored in the Eluate Contingency Storage Vessel (CNP-VSL-00003), which is equipped with a cooling jacket for heat removal.

The Cesium Evaporator Separator Vessel (CNP-EVAP-00001) is fed through a break pot and the Cesium Evaporator Eluant Lute Pot (CNP-VSL-00001) in order to create a hydraulic seal to maintain a vacuum in the Cesium Evaporator Separator Vessel (CNP-EVAP-00001).

The recovered nitric acid is periodically sampled and, depending on the acid concentration of the recovered acid sample, some pH adjustment may be necessary. Fresh 2 molar nitric acid is available to the Cesium Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004) along with process condensate to adjust the recovered acid concentration as required.

The CNP system only operates when a Cesium Ion Exchange Column (CXP-IXC-00001/ 2/3/4) is in the process of having its resin bed regenerated through an elution process. When elution of a cesium ion exchange column is not taking place, the nitric acid recovery system is maintained in a standby mode. The major vessels of the CNP system are equipped with internal wash rings for decontamination of the system.

The primary design features of the CNP system are:

- Instrumentation for monitoring and control of vessel liquid level.
- Pulse jet mixers in the Eluate Contingency Storage Vessel (CNP-VSL-00003) and the Cs Evaporator Recovered Nitric Acid Vessel (CNP-VSL-00004).
- Passive vessel overflow routes from the Eluate Contingency Storage Vessel, and the Cs Evaporator Recovered Nitric Acid Vessel
- Connection of the vessel vapor space and condensers to the Pretreatment Vessel Vent Process (PVP) System.

~~The CNP recovers nitric acid that was previously used for cesium ion exchange resin bed regeneration so that the nitric acid can be reused. In addition, this system concentrates and transfers to storage the cesium extracted from the ion exchange system for incorporation into the HLW melter feed.~~

~~The main components of the CNP are:~~

- ~~The evaporator and reboiler~~
- ~~A rectifier column~~
- ~~Primary and after-condensers~~
- ~~A pulse pot~~
- ~~Cesium concentrate lute pot (V13030)~~
- ~~Eluate contingency storage vessel (V13073)~~
- ~~Recovered nitric acid vessel (V13028)~~

During the process of regenerating the cesium ion exchange resin beds, eluate composed of cesium-bearing nitric acid will be fed to the nitric acid recovery evaporator operating under reduced pressure. A closed-loop circulation stream is fed from the evaporator to the steam heated reboiler and back to the evaporator. This heat input is the motive force for the evaporative process.

Vapors from the evaporator, composed primarily of water and nitric acid, are sent to the refluxed rectifier column where the nitric acid is recovered. Recovered nitric acid is collected in the recovered nitric acid vessel for reuse in the regeneration of cesium ion exchange column resin beds. Water vapor is recovered from the system's primary and after-condenser routed through the waste feed evaporator, and collected in the plant wash and disposal (PWD) system. These condensers are water cooled shell-and-tube heat exchangers. The effluent collected from these condensers is neutralized before being recycled to the Treated LAW Evaporator Process System (TLP). Uncondensed vapors exiting from the after-condenser are routed to the PVP for further treatment.

The cesium concentrated in the evaporator is routed to the HLW feed blending vessel (V12007), for blending and incorporation into the HLW melter feed stream. This cesium concentrate may also be stored in the eluate contingency storage vessel which is equipped with cooling coils for heat removal.

Because the cesium nitric acid recovery evaporator operates under reduced pressure, the feed stream to the evaporator is passed through a pulse pot and enters the evaporator through the cesium concentrate lute pot. This process maintains the negative pressure on the evaporator system. The concentrated cesium stream extracted from the evaporator also passes through the cesium concentrate lute pot.

Some nitric acid is consumed during the elution process requiring that fresh acid be added to the recovered nitric acid stream to bring the contents back to the original volume. Depending on the concentration of the recovered acid sample, some pH adjustment may be necessary. Fresh nitric acid is delivered to the recovered nitric acid vessel, as necessary.

The CNP only operates when a cesium ion exchange column is in the process of having its resin bed regenerated through an elution process. When elution of a cesium ion exchange column is not taking place, the nitric acid recovery system is maintained in a standby mode. The major vessels of the CNP are equipped with internal wash rings for decontamination of the system.

Instrumentation, alarms, controls, and interlocks will be provided for the CNP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high-liquid-level instrumentation interlocks to shut off feed sources, and PCS control

~~functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.~~

- ~~Cooling system failure in concentrate storage vessel: Due to the heat generated in the eluate contingency storage vessel from cesium decay, two cooling coils (one operating and one spare) with a cooling water supply are provided for temperature control. If a failure should occur in the cooling water system, the vent system is designed to remove adequate heat to delay the advent of boiling of the concentrate. A process water line is available for makeup water to the vessel to counteract evaporation of the water in the concentrate.~~
- ~~Loss of containment: Vessel containment loss is detected by liquid level indication in the cell sump, and in the event of an extremely low liquid level, PCS controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, contains liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.~~
- ~~Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the evaporator will automatically shut down.~~
- ~~Inadvertent transfers of fluids: System sequential transfer operations are interlocked.~~

4.1.2.7 Cesium Resin Addition Process (CRP) System

Figure 4A-11 presents a simplified process flow diagram of the Cesium Resin Addition Process (CRP) System. The purpose of the CRP tank system is to provide a means to add fresh resin to the Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4). The system provides for preparation of the fresh cesium resin by hydraulically removing fines from the bulk of the resin particles as well as chemically conditioning the fresh resin. After conditioning, the resin is transferred to the ion exchange columns as a slurry, by gravity flow.

The main components of the CRP tank system are:

- Cesium Resin Addition Vessel (CRP-VSL-00001)
- Cesium Resin Addition Air Gap Vessel (CRP-VSL-00002)
- Cesium resin addition recycle pump
- Pumps, piping, and instrumentation for waste transfers
- Text provided for informational purposes only

Cesium is removed from the LAW feed using the ion exchange resin. Each batch of the resin has a limited useful operating life after which it must be removed from the ion exchange column and replaced with fresh resin.

Fresh resin is delivered per specification by the vendor. It is then transferred from bulk storage with the aid of handling equipment to the resin addition room. The resin is transferred from the shipping container to the Cesium Resin Addition Vessel (CRP-VSL-00001) with an eductor and demineralized water. After transfer, the cesium resin undergoes resin conditioning processes. The resin is then transferred to a Cesium Ion Exchange Column (CXP-IXC-00001/2/3/4) as a slurry by gravity flow.

There is a Cesium Resin Addition Air Gap Vessel (CRP-VSL-00002), located on the slurry downcomers to the Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4) in the resin addition valve bulge. The function of the Cesium Resin Addition Air Gap Vessel (CRP-VSL-00002) is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the Cesium Resin Addition Vessel (CRP-VSL-00002). In the unlikely event of back-flow into the Cesium Resin Addition Air Gap Vessel (CRP-VSL-00002), gas is vented to the Pretreatment Vessel Vent Process (PVP) System and other constituents overflow into the Plant Wash Vessel (PWD-VSL-00044) of the Plant Wash and Disposal Process (PWD)System.

The cesium resin must be conditioned before processing the LAW feed stream through the Cesium Ion Exchange Columns (CXP-IXC-00001/2/3/4). The purpose of conditioning is to fully expand the resin and convert the resin into the right ionic form for cesium removal.

The primary design features of the CRP system are:

- Instrumentation for monitoring and control of vessel liquid level.
- Passive vessel overflow routes from the Cesium Resin Addition Vessel (CRP-VSL-00001).
- Connection of the Vessel vapor space to the Pretreatment Vessel Vent Process (PVP) System.

~~The purpose of the CRP is to provide a means to add fresh resin to the cesium ion exchange columns. The system provides for preparation of the fresh cesium resin by hydraulically removing fines from the bulk of the resin particles, as well as transfer to the ion exchange columns as a slurry, by gravity flow. The cesium resin is chemically conditioned after transfer to a column. The CRP is located at a point over the cesium ion exchange columns which allows optimum operational efficiency.~~

~~Cesium is removed from the LAW feed using the ion exchange resin. Each batch of the resin has a limited useful operating life after which it must be removed from the ion exchange column and replaced with fresh resin.~~

~~Fresh resin is delivered per specification by the vendor. It is then transferred from bulk storage with the aid of handling/conveying equipment to a feed hopper mounted on the top of the cesium resin addition vessel. The cesium resin undergoes resin conditioning processes in the cesium ion exchange columns; therefore, only water is added prior to~~

adding the cesium resin into the vessel. The resin is transferred to an ion exchange column as a slurry by gravity flow.

There is an air gap vessel, located on the slurry downcomers to the cesium ion exchange columns in the resin addition valve bulge. The function of the air gap vessel is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the resin addition vessel. In the unlikely event of back-flow into the air gap vessel, gas is vented to the PVP and other constituents overflow into the plant wash vessel.

The cesium resin must be conditioned before processing the LAW feed stream through the ion exchange column. The purpose of conditioning is to fully expand the resin and convert the resin into the right ionic form for cesium removal. The cesium ion exchange resin is conditioned in the ion exchange column to utilize disposition of the acidic and caustic conditioning solutions through plant processes.

Instrumentation, alarms, controls, and interlocks will be provided for the CRP indicate or prevent the following conditions:

- Pressure in cesium resin addition vessel: High pressure will alarm; interlock to check vessel status and readiness to receive resin.
- Level in cesium resin addition vessel: Vessel is equipped with level controller; alarms at high level and low level; appropriate transfer valves automatically closeoperator.
- Pressure in cesium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.
- Vacuum in cesium resin addition vessel: At a set pressure level, atmospheric air is drawn in.
- Level in cesium resin overflow tank: At high level, flow from the screen is shut off.
- Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.
- Differential pressure across the fines overflow filter: A high differential pressure indicating a plugged filter will be alarmed. A low differential pressure indicates failure of the filter.

4.1.2.8 Technetium Ion Exchange Process System (TXP)

The primary function of the TXP is to remove technetium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts technetium.

The main components of the TXP are:

- Four technetium ion exchange columns (C43006, C43007, C43008, and C43009) for technetium removal
- Three treated LAW buffer vessels (V43110A, V43110B, and V43110C)
- A technetium ion exchange buffer vessel (V43001)
- A caustic rinse collection vessel (V43056) with reverse flow diverters
- Two technetium feed pumps and associated piping

Other equipment associated with this system includes the technetium reagent vessel for caustic solutions and process water addition and two transfer pumps for reagents and water flushes.

The TXP uses four columns operating in series. At any given time, only three of the ion exchange columns operate in the loading cycle, removing technetium from the LAW feed stream. The order of these columns may be rotated in series so that any of the columns may be in the lead position. The remaining ion exchange column is being eluted, having its spent resin replaced, or is in a standby mode. After a lead column is eluted, it typically becomes a lag column in the next loading cycle.

The concentration of technetium in the treated LAW is monitored between columns and on the inlet line to the treated LAW buffer vessels. When technetium is detected above an established set point following an ion exchange column, that column is taken out of the loading cycle and the resin bed is regenerated, while the column that was out of service is returned to the loading cycle.

Elution is part of the resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed in the column by rinsing with dilute caustic solution to prevent the precipitation of aluminum hydroxide.
- Rinsing of the ion exchange column with process water to prevent caustic from mixing with eluate that is transferred to the technetium eluant recovery system during the elution step.
- Elution of sodium pertechnetate on the loaded resin with warm water from the eluant recovery system.
- pH adjustment of the resin bed by flushing with sodium hydroxide solution to prevent precipitation of aluminum hydroxide during subsequent LAW feed processing.

The eluate from the resin bed regeneration is collected and transferred to the Technetium Eluant Recovery Process System (TEP) for recycling. The concentration of technetium in the eluate is monitored until only limited concentrations of technetium are detected in the eluate leaving the column. The process water eluate is sent to the technetium eluate receipt vessels for further processing to recover the concentrated technetium product. The water is recovered in the technetium eluant recovery system for reuse as eluant.

After a number of loading and regeneration cycles the resin is expected to lose performance and is termed "spent." The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column to the Spent Resin Collection and Dewatering Process System (RDP). A slurry of fresh resin is then added to the column as a bed replacement.

Instrumentation, alarms, controls, and interlocks will be provided for the TXP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, and high-level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Overpressurization: Pressure relief for each ion exchange column is provided by a relief valve that discharges to a piping header that is vented in the technetium reagent vessel.
- Loss of containment: Vessels are protected against containment loss by liquid level indication, low-level interlocks to shut off feed sources and PCS control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel, and sump level instrumentation detects liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverters system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.
- Column venting: The valves for each ion exchange column are interlocked with the column vent valve so that the vent valve closes when feed valves open to the ion exchange column. Similarly, the vent valve is closed during spent resin removal. The vent valve opens when a column is idle.

4.1.2.9 Technetium Eluant Recovery Process System (TEP)

The TEP recovers water from the eluate that was previously used for technetium ion exchange resin bed regeneration so that it may be reused. In addition, this system concentrates and transfers to storage the technetium extracted from the ion exchange system for incorporation into the HLW melter feed.

The main components of the TEP are:

- Technetium eluant recovery evaporator (V43069) and reboiler
- A rectifier column
- Primary and after-condensers
- A pulse pot
- Technetium concentrate lute pot (V43072)
- Eluate contingency storage vessel (V13073, included in the Cesium Nitric Acid Recovery Process System [CNP])
- Recovered technetium eluant vessel (V43071)

During the process of regenerating the technetium ion exchange resin beds, eluant composed primarily of technetium-bearing water will be fed to the technetium eluant recovery evaporator operating under reduced pressure. A closed loop circulation stream is fed from the evaporator to the steam heated reboiler and back to the evaporator. This heat input is the motive force for the evaporative process.

Vapors from the evaporator, composed primarily of water vapors, are sent to the refluxed rectifier column, where the majority of the water is recovered in the rectifier column underflow. This recovered water is collected in the recovered technetium eluant vessel for reuse in the regeneration of technetium ion exchange column resin beds. Additional water vapors are recovered from both of the systems condensers (primary and after-condenser) and the condensate is routed to the Plant Wash and Disposal System (PWD). These condensers are water cooled shell-and-tube heat exchangers. Uncondensed vapors exiting from the after-condenser are routed to the PVP for further treatment.

The technetium concentrated from the evaporator is routed to the HLW feed blending vessel (V12007), for blending and incorporation into the HLW melter feed stream. The technetium concentrate from the evaporator can alternatively be stored in the eluate contingency storage vessel.

Because the technetium eluant recovery evaporator operates under reduced pressure, the feed stream to the evaporator is passed through a pulse pot and enters the evaporator through a lute pot. This process maintains the negative pressure on the evaporator system. The concentrated technetium stream extracted from the evaporator also passes through a lute pot.

The TEP only operates when a technetium ion exchange column is in the process of having its resin bed regenerated through an elution process. When elution of a technetium ion exchange column is not taking place, the TEP is maintained in a standby mode. The major vessels of the TEP are equipped with internal wash rings for decontamination of the system.

Instrumentation, alarms, controls, and interlocks will be provided for the CRP indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the evaporator will automatically shut down.
- Inadvertent transfers of fluids: System sequential transfer operations are interlocked.

4.1.2.10 Technetium Resin Addition Process System (TRP)

The purpose of the system is to provide a means to add fresh resin to the technetium ion exchange columns. The TRP provides for preparation of the technetium resin by hydraulically removing fines from the bulk of the resin particles. The system also provides for transfer to the ion exchange columns as a slurry by gravity flow. The resin is chemically conditioned in the ion exchange column. The system is located at a point over the technetium ion exchange columns which allows optimum operational efficiency.

Technetium is removed from the LAW feed stream using an ion exchange resin. Each batch of the resin has a limited useful life after which it must be removed from the ion exchange column and replaced with fresh resin.

Fresh resin is added to, prepared in and slurried for transfer from the technetium resin addition vessel. Process water is added to make up the required slurry which is gently agitated mechanically to suspend the fine particles. Next, fines are removed from the slurry. The resin is gravity transferred as a slurry to the technetium ion exchange columns. The conditioning process involves soaking the resin in caustic. There is an air gap vessel located at the four slurry downcomers to the technetium ion exchange columns in the resin addition valve bulge. The function of each air gap vessel is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the resin addition vessel.

Instrumentation, alarms, controls, and interlocks will be provided for the TRP indicate or prevent the following conditions:

- Pressure in technetium resin addition vessel: High pressure will alarm; interlock to check vessel status and readiness to receive resin.
- Level in technetium resin addition vessel: Vessel is equipped with level controller; alarms at high level and low level; appropriate transfer valves automatically close.
- Pressure in technetium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.
- Vacuum in technetium resin addition vessel: At a set pressure level, atmospheric air is drawn in.
- Level in technetium resin overflow tank: At high level, flow from the screen is shut off.
- Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.
- Differential pressure across the fines overflow filter: A high differential pressure indicating a plugged filter will be alarmed. A low differential pressure indicates failure of the filters.

4.1.2.11 Treated LAW Evaporation Process (TLP) System

Figure 4A-16 presents a simplified process flow diagram of the Treated LAW Evaporation Process (TLP) System. The primary function of the TLP tank and miscellaneous unit system is to concentrate treated LAW from the Cesium and Technetium Ion Exchange Process (CXP) System.
The main components of the TLP tank and miscellaneous unit system are as follows:

- Receive waste from the treated LAW collection vessels following technetium removal
- Receive and neutralize submerged bed scrubber purge from LAW vitrification
- Evaporate a portion of the feed (reducing the volume and increasing the sodium concentration)
- Transfer the waste to the Treated LAW Concentrate Storage Process System (TCP)
- Condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD)
- Vent non-condensable gases to the PVP for treatment

Tank System

- LAW Submerged Bed Scrubber (SBS) Condensate Receipt Vessels (TLP-VSL-00009A/B)
- Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002)

- Pumps, piping, and instrumentation for waste transfers

Miscellaneous Unit Systems

- Treated LAW Evaporator Separator Vessel (TLP-SEP-00001)
- Pumps, piping, and instrumentation for waste transfers
- Reboiler (TLP-RBLR-00001)
- Concentrate pumps with outlet valve header
- Primary Condenser (TLP-COND-00001)
- Inter-Condenser (TLP-COND-00002)
- After-Condenser (TLP-COND-00003)

Subsequent to sampling and analysis, the treated LAW is pumped continuously from one of three Cesium Ion Exchange Treated LAW Collection Vessels (CXP-VSL-00026A/B/C) to the evaporator system. The Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) will deliver treated LAW concentrate to the Treated LAW Concentrate Storage Process (TCP) System.

The TLP system also evaporates recycle streams from the Treated LAW Concentrate Storage Process (TCP) System and the Radioactive Liquid Waste Disposal Process (RLD) System, and submerged bed scrubbers in the LAW Plant. Overhead vapors from the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) are routed to the Primary Condenser (TLP-COND-00001). Process condensate from the Primary Condenser, Inter-Condenser, and After-Condenser (TLP-COND-0001) are collected in the Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002) and discharged to the RLD system. The noncondensables from the condenser train are discharged to the Pretreatment Vessel Vent Process (PVP) System.

The TLP feed system includes two LAW SBS Condensate Receipt Vessels (TLP-VSL-00009A/B) for managing submerged bed scrubber recycles from LAW vitrification and pretreatment process recycles. One vessel will be in an accumulation mode while the alternate vessel is feeding the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001).

The primary design features of the TLP feed components include:

- Internal pulse jet mixers for solids suspension
- Instrumentation for monitoring of vessel liquid level
- Vessel vent to the PVP system
- Passive air purge of the vessel vapor space
- Pump and line flushing capability
- Transfer flow rate indication and transfer volume totalizer

- Remote sampling capability off the discharge of the transfer pumps
- Vessel spray rings for vessel decontamination

The Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) is a forced-circulation unit operating under vacuum to reduce the operating temperature. A recirculation pump maintains a high flow rate from the evaporator separator vessel to the Reboiler (TLP-RBLR-00001). The pump transfers the waste through the Reboiler and back into the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001). The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head (submergence) above the reboiler tubes.

As the liquid travels out of the Reboiler (TLP-RBLR-00001), the hydrostatic head diminishes and flash evaporation occurs as the flow enters the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001). The liquid continues to flash and the vapor and liquid streams are separated (liquid-vapor disengagement). The liquid stream circulates in this loop and becomes more concentrated, while the vapor stream passes through a demisting section to the evaporator condensers. A portion of the concentrate is also pumped from the bottom of the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) at the controlled liquid density and is discharged to the TCP system as feed to LAW vitrification.

The primary design features of the evaporator trains include:

- Operating pressure indication and control
- Differential pressure indication across the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) demister section
- Water sprays to the treated LAW Evaporator Separator vessel (TLP-SEP-00001) demister section
- Process condensate radiation monitoring and recycle capability
- Low-pressure steam supply for heating the Reboiler (TLP-RBLR-00001)
- Reboiler (TLP-RBLR-00001) tube leak detection and diversion capability
- Reboiler (TLP-RBLR-00001) steam condensate collection
- Instrumentation for monitoring and control of vessel liquid level
- Passive venting via the downstream vessels connected to the vent header
- Capability to drain, flush, and chemically clean the system

The vapor stream exiting the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) is condensed in a three-stage condenser system consisting of a Primary Condenser (TLP-COND-00001), an Inter-Condenser (TLP-COND-00002), and an After-Condenser (TLP-COND-00003). A two-stage high-pressure steam vacuum system between the condensers maintains an operating pressure of approximately 1 psi on the

Treated LAW Evaporator Separator Vessel (TLP-SEP-00001). The noncondensables exiting downstream of the After-Condenser (TLP-COND-00003) are routed to the PVP system for treatment.

The primary design features for vapor stream management include:

- Instrumentation for monitoring and control of vessel liquid level
- Vessel vent to the PVP system to prevent pressurization of a vessel
- Remote sampling capability of the transfer pump discharge
- Dip legs in the vessel that maintain a liquid seal (pressure boundary) between the vessel and the condensers
- Makeup recycle water as required for startup

The condensed vapor from the condensers is collected in the Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002). A small fraction of the total condensate is recycled to the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001) demister water sprays. The balance of the condensate is transferred to the RLD system.

Condensate from the primary condenser is monitored for radioactivity. In the event of radioactivity breakthrough being detected, a Treated LAW Evaporator Separator (TLP) System shutdown is initiated and the contents of the Treated LAW Evaporator Condensate Vessel (TLP-VSL-00002) are transferred to a LAW SBS Condensate Receipt Vessels (TLP-VSL-00009A/B).

~~The primary functions of the TLP are as follows:~~

- ~~Receive waste from the treated LAW collection vessels following technetium removal~~
- ~~Receive and neutralize submerged bed scrubber purge from LAW vitrification~~
- ~~Evaporate a portion of the feed (reducing the volume and increasing the sodium concentration)~~
- ~~Transfer the waste to the Treated LAW Concentrate Storage Process System (TCP)~~
- ~~Condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD)~~
- ~~Vent non-condensable gases to the PVP for treatment~~

~~The TLP is composed of a single evaporator train and contains the following main components:~~

- ~~Two LAW submerged bed scrubber purge receipt vessels (V45009A and V45009B)~~

- A single evaporator train composed of the LAW evaporator separator vessel (V41011) equipped with demisters, a reboiler, a recirculation pump, and overhead condensers
- A single evaporator condensate pot (V41013)
- Pumps and associated piping for transfer of waste

The treated LAW evaporator is a forced-circulation unit operating under a vacuum to reduce the operating temperature. The treated LAW from the TXP will be transferred to the TLP. The treated LAW buffer vessels (V43110A/B/C) will be configured in such a way that one will be filling, one will be feeding the LAW evaporator separator vessel, and one will be full, empty, or out-of-service. Submerged bed scrubber purge liquor from the LAW vitrification plant is receivedand neutralized in one vessel while being fed to the LAW evaporator separator vessel from another vessel. Additionally, off-specification effluent may be received from the Plant Wash and Disposal System (PWD).

The two feeds to the LAW evaporator separator vessel are pumped continuously to the recirculation pump.

The recirculation pump maintains a high flow rate around the evaporation system. The recirculation pump transfers the waste through the reboiler and back into the LAW evaporator separator vessel. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.
decontamination
As the liquid travels through the reboiler, the hydrostatic head diminishes and flash evaporation occurs as the flow enters the LAW evaporator separator vessel. The liquid continues to flash and the vapor and liquid streams are separated. The liquid stream circulates in this closed loop (becoming more concentrated), while the vapor stream passes to the evaporator overhead system.

The concentrated waste stream is pumped continuously out of the evaporator system. The concentrate off-take is situated on the suction line of the recirculation pump. The concentrated waste stream is discharged to the treated LAW buffer vessels (V43110A/B/C).

-

The vapor stream from the evaporator is condensed in the overheads system which contains a multi-stage condenser system consisting of a primary condenser, an intercondenser, and an aftercondenser condensers. The non-condensables from the aftercondenser pass through the demister, which removes entrained droplets. The non-condensables are then routed to the PVP for treatment. The condensed vapor from the overheads system is collected in a condensate pot and then transferred to process condensate vesselsin the RLD for discharge to the ETF. If contaminated, the condensate from the system is recycled back through the TLP.

Condensate from the primary condenser is monitored continuously for activity. In the event of activity breakthrough being detected, a treated LAW evaporator system shutdown is initiated and the contents of the evaporator condensate pot are transferred to a LAW submerged bed scrubber purge receipt vessel.

The evaporator recirculation pump will not automatically be stopped in case of a treated LAW evaporator process system shutdown. This is to prevent settling of solids within the recirculation loop, which may cause a blockage.

Instrumentation, alarms, controls, and interlocks will be provided for the TLP indicate or prevent the following conditions:

- High level in separator vessel: Stop evaporator feed pumps.
- Low level in separator vessel: Stop concentrate take-off pumps.
- Breakthrough detected in condensate pot: Close clean condensate transfer valves and recycle contaminated condensate to receipt vessel.
- Low level in condensate pot: Close condensate transfer valves.

4.1.2.12 Treated LAW Concentrate Storage Process (TCP) System

Figure 4A-16 presents a simplified process flow diagram of the Treated LAW Concentrate Storage Process (TCP) System. The primary function of the TCP system is to receive treated LAW concentrate from the Treated LAW Evaporation Process (TLP) System and store the material for subsequent batch transfer to the LAW vitrification plant.

The main components of the TCP tank system are:

- Treated LAW Concentrate Storage Vessel (TCP-VSL-00001)
- Pumps for transferring treated LAW concentrate
- Three waste transfer lines to LAW vitrification
- Vessel inlet and outlet valve headers
- Pumps, piping, and instrumentation for waste transfers

Dilute treated LAW direct from the Cesium Ion Exchange Process (CXP) System can also be received and stored in the TCP system (evaporator by-pass option). The Treated LAW Concentrate Storage Vessel (TCP-VSL-00001) provides approximately 7 days of lag storage to sustain ILAW glass production if the pretreatment processing is interrupted.

Out-of-specification treated LAW concentrate can be recycled to the waste feed receipt process system (FRP) for rework through pretreatment, or recycled to the TLP system for blending and additional evaporation. Under strict administrative control (sampling and jumper installation), the Treated LAW Concentrate Storage Vessel (TCP-VSL-00001) can also receive washed and leached solids directly from the UFP system if the solids meet treated LAW feed specification.

During commissioning, treated LAW concentrate may be stored in a dedicated FRP vessel for additional lag storage capacity. Transfers from and to the TCP and FRP systems will also be under strict administrative control (sampling and jumper installation).

Treated LAW concentrate is batch-transferred from the tank to LAW vitrification through the inner pipe of any one of three co-axial transfer lines (two connected, one unconnected spare). The inlet and outlet valve headers and pumps are used in combination to facilitate circulation and sampling, forward transfer to LAW vitrification, and recycle to the TLP system or FRP system.

The primary design features of the TCP system include:

- Capability to pressure test both the inner and outer transfer lines for integrity
- Transfer line leak detection system for integrity indication during transfer
- Transfer line flushing and draining capability
- Instrumentation for monitoring vessel liquid level
- Vessel vent to the PVP system
- Direct steam injection to maintain the concentrate temperature above the saturation temperature to prevent precipitation
- Internal pulse jet mixers (PJMs) for solids suspension and slurry mixing
- Remote sampling capability off the discharge of the transfer pump
- Vessel spray rings for vessel decontamination
- Administrative controls and radiation monitoring to ensure that treated LAW transferred into and from the vessel meets waste specification for LAW vitrification.

The TCP system pumps and valve headers exposed to low radiation potential are located in a C3/R3 area for ease of maintenance.

~~The primary functions of the TCP are to receive treated waste from the pretreatment process, to provide buffer storage capacity, and to transfer waste to the LAW vitrification plant.~~

~~The main components of the TCP are:~~

- LAW buffer storage vessel (V41001) equipped with steam injection heating
- Pulse jet mixer
- Transfer pump and associated piping

Treated LAW concentrate is normally received by the LAW buffer storage vessel from the treated LAW evaporator in the TLP.overflown
Pulsejet mixers will agitate the contents of the LAW buffer storage vessel. Agitation of tank contents ensures that solids in the treated LAW concentrate are suspended prior to transfer, improves heat transfer into the solution from steam injection, and prevents the settling of solids. The temperature of the LAW buffer storage vessel will be monitored and controlled with steam injection to avoid precipitation of solids.

Treated LAW concentrate will be transferred to the LAW vitrification plant via pipelines within underground trenches. A duty and standby pipeline will be installed to minimize disruptions to facility throughput in the event of a leak. The pipelines will be coaxial to detect and contain leaks. Following a treated LAW concentrate transfer, the pipe will be flushed with two pipe volumes of water to clear the line and minimize the chance of the line blocking. The transfer pipe and annulus will drain to a Plant Wash and Disposal System (PWD) vessel.

The following list provides an overview of the safety and interlock features for the TCP:

- Normal operation control at high level: Stop PCS controlled transfer sequence.
- Failure of the PCS to stop transfer sequence: PCS software trip and alarm on PCS sources of feed.
- Failure of PCS software: If required, the hardwired trip would act on PCS sources of feed and on isolation valves.

4.1.2.13 Spent Resin Collection and Dewatering Process (RDP) System

Figure 4A-15 presents a simplified process flow diagram of the Spent Resin Collection and Dewatering Process (RDP) System. The RDP system provides for the periodic removal of spent cesium and technetium ion exchange resin.

The primary components of the RDP system include:
- Spent Resin Slurry Vessels (RDP-VSL-00002A/B/C)
- Spent Resin Dewatering Moisture Separation Vessel (RDP-VSL-00004)
- Pumps, piping, and instrumentation for waste transfers

Resin is first eluted and then hydraulically discharged under pressure from the ion exchange column by fluidizing the bed of resin with demineralized water or caustic solution. The spent resin collection process is initiated by flushing an eluted Cesium and Technetium Ion Exchange Column (CXP-IXC-00001/2/3/4) and hydraulically discharging the contents into a Spent Resin Slurry Vessel (RDP-VSL-00002A/B/C). In these vessels, the resin slurry will be circulated, monitored for cesium and technetium content, and delivered to a sampling system to determine whether the resin is in compliance with the receiving TSD unit's waste acceptance criteria. Spent resins that meet the receiving TSD unit's waste acceptance criteria will be dewatered, containerized, and transferred to a TSD unit.

Spent resin is removed from each Cesium and Technetium Ion Exchange Column (CXP-IXC-00001/2/3/4) independently as a batch operation. Spent resin slurry from the ion exchange columns is collected in the three spent resin collection vessels, which are interchangeable and will be capable of storing transport liquid and resin slurry. Once in the spent resin slurry vessel, the resin slurry will be mixed by pulse jet mixers and monitored for radiation (gamma) content in a circulation loop to determine if elution has sufficiently removed radionuclides from the resin for disposal.

Resin that does not meet the predetermined treatment limits will be routed back to the Cesium and Technetium Ion Exchange Columns (CXP-IXC-00001/2/3/4) for additional elution. After completing the additional elution, the resin is transferred back to a Spent Resin Slurry Vessels (RDP-VSL-00002A/B/C/D) where it is processed again.

Following assurance that the spent resin is in compliance with the receiving TSD unit's acceptance criteria, the resin is pumped to the disposable spent resin dewatering container. When the transfer operation is completed, water is used to flush resin remaining in the transfer pump and line to the spent resin dewatering container.

There are three steps to resin dewatering. First, a gross dewatering removes excess water as the slurry is pumped to the disposal container. Next, a dewatering pump is used to remove standing water above the resin bed. Finally, circulation of a warm, dry air stream through the spent resin in the container evaporates the remaining liquid. The moist air stream leaving the dewatering container is cooled in the Spent Resin Dewatering Moisture Separation Vessel (RDP-VSL-00004) where the moisture is condensed and separated. The dry air from the spent resin dewatering moisture separation vessel is circulated past a heater and through the resin again. When the water content in the resin is reduced to an acceptable level, the dewatering operation is complete.

The primary design features of the RDP system are:

- Instrumentation for monitoring and control of vessel liquid level
- Pulse jet mixers in the Spent Resin Slurry Vessels (RDP-VSL-00002A/B/C).
- Passive vessel overflow routes from the Spent Resin Slurry Vessels.
- Remote sampling capabilities on the discharge transfer pumps.
- Connection of the vessel vapor spaces to the Pretreatment Vessel Vent Process (PVP) System.

The RDP provides for the periodic removal of spent cesium and technetium ion exchange resin and the subsequent replacement with fresh resin.

The primary components of the RDP include:

- Two spent resin collection vessels (V43135A and V43135B)
- A resin flush collection vessel (V43136)
- Resin dewatering moisture separation vessel

The spent resin collection process is initiated by flushing an eluted ion exchange column and hydraulically discharging the contents into either of two spent resin collection vessels. In these vessels, the resin slurry will be circulated, monitored for cesium and technetium content, and delivered to a sampling system to determine whether the resin is in compliance with the receiving TSD unit's waste acceptance criteria. Spent Resin that does not meet the predetermined treatment limits for cesium and technetium content will be routed back to the ion exchange columns for re-elution. Spent resins that meet the receiving TSD unit's waste acceptance criteria will be dewatered, containerized, and stored within the pretreatment plant until transferred to a Hanford TSD unit.

At times, internal decontamination of vessels may be required. The vessels are fitted with wash rings for decontamination by flushing. Wash systems will be able to introduce water, caustic solution, or acid. The stainless steel-clad cell is also fitted with a cladding wash system for decontamination of the walls and floor.

Spent Resin Removal

Spent resin is removed from each ion exchange column independently as a batch operation. Resin is first eluted and then hydraulically discharged under pressure from the ion exchange column by fluidizing the bed of resin with a flush liquor (dematerialized water or caustic solution). The resin flush liquor is stored in the resin flush collection vessel and is delivered to the ion exchange columns by transfer pump.

Spent resin slurry from the ion exchange columns is collected in the two spent resin collection vessels. In order to obtain good resin fluidization and subsequent transfer to the resin dewatering container, water above the resin is recirculated through eductors installed inside each vessel at two levels. The function of the upper eductors located in the water above the settled resin bed is to create the jet mixing action and necessary velocity to initiate the mixing of resin and water. The lower eductors induce vortexes over the entire vessel volume to assure uniform suspension of the resin. Process water may be used as necessary to adjust the resin concentration. No additional fresh water is introduced into the vessels until lines are flushed at the end of a resin transfer.

The spent resin from the spent resin collection vessels is transferred to the dewatering container by recirculating the liquid through mixing eductors and into the resin bed at the bottom of the collection vessels. The recirculating resin is monitored for cesium (gamma) or technetium (beta) by radiation monitors to determine if cesium and technetium have been sufficiently removed from the resin for disposal. Spent resin that contains cesium in excess of allowable limits is recycled to a cesium ion exchange column for an additional elution cycle. Spent resin that contains technetium in excess of allowable limits is recycled to a technetium ion exchange column for an additional elution cycle. After completing the additional elution cycle, the resin is transferred back to the spent resin collection vessels where it again begins recirculation. The spent resin is also analyzed to assure it complies with the receiving TSD unit's waste acceptance criteria.

Resin Dewatering

Following assurance that the spent resin is in compliance with the receiving TSD unit acceptance criteria, the pump discharge to the dewatering container is opened to fill the waste container to a predetermined level. When the transfer operation is completed, process water is used to flush resin remaining in the transfer pump and line to the dewatering container and the suction line is flushed back into the two spent resin collection vessels.

First, a gross dewatering removes excess water while the resin is pumped to the container and after it enters the container. Next, a dewatering vacuum pump is used to remove water from the resin. The container filtration system includes a moisture separator vessel. Circulation of a warm, dry air stream through the spent resin picks up moisture. The moist air stream is cooled and circulated to the moisture separation vessel where the moisture (water droplets) is separated. The blower sucks the dry air from the separation vessel and circulate the air to the resin again. When the water content in the resin is reduced to an acceptable level, the resin is dewatered.

The resin flush collection vessel receives flush liquor from the resin dewatering operation, and also receives resin transport liquor from the cesium and technetium ion exchange columns during the addition of fresh resin. The streams are stored for reuse as resin flush liquor. If the combined inputs into the resin flush collection vessel exceed its storage capacity, then the excess liquor is recycled to the Waste Feed Evaporator Process System (FEP). A resin flush transfer pump can be used to recirculate liquor to the resin flush collection vessel in order to mix the contents of the vessel and allow for sampling prior to transfer of the flush liquor to the resin flush collection vessel.

Instrumentation, alarms, controls, and interlocks will be provided for the RDP indicate or prevent the following conditions:

- Overfilling: System vessels and the dewatering container are protected against overfilling by liquid level indication, high-level instrumentation interlocks to shut off feed sources, and PCS control functions backed up by hard-wired trips as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.

- Loss of containment: Vessels are protected against containment loss by liquid level indication, and by PCS control and alarm functions as required, including shut-off of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system. The cell is lined with stainless steel and sump liquid level instrumentation will detect liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Loss of pumping function: Operation of pumps is not permitted or pumps are shut down if there is indication that the pumping system has plugged, lost its integrity, or ceased to function properly, or if pumping/receiving vessel conditions warrant a pump shutdown. These conditions could be indicated by:
  - High or no electrical current indication
  - Abnormal pumping/receiving vessel conditions

4.1.2.14 Pretreatment Maintenance

The pretreatment plant will include maintenance facilities that will enable remote and hands-on maintenance of process equipment, and will consist of the following systems:

- Pretreatment in-cell handling system (PIH)
- Pretreatment filter cave handling system (PFH)
- Radioactive solid waste handling system (RWH)

The individual systems and their primary functions are described below:

Pretreatment In-Cell Handling (PIH) System
The purpose of this system is to decontaminate and perform maintenance on equipment in the hot cell and/or dispose of hot cell equipment. The PIH system will perform the following functions:

- Decontaminate contaminated equipment using the wash down sprays followed by the Decontamination Soak Tank (PIH-TK-00001)
- Collecting liquids in catch pans
- Holding components while doing work using fixtures
- Disassembling, repairing, and reassembling failed contaminated process equipment remotely

Typical process equipment that the system will handle are pumps, valves, jumpers, small vessels, and other ancillary equipment and/or tools. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Size reduction equipment (cutters, shears, etc.)
- Crane deployed equipment, such as impact wrenches and spreader bars
- Fixtures
- Decontamination equipment (carbon dioxide, wash down, Decontamination Soak Tank [PIH-TK-00001])
- Manipulator-operated assembly/disassembly tools used in repair
- Turntables
- Pumps, piping, and instrumentation for waste transfers

Pretreatment Filter Cave Handling (PFH) System

The purpose of this system is to provide a method for performing maintenance on ventilation equipment in the filter cave. The equipment in this system will provide the following functions:

- Lifting, holding, transporting, installing/uncoupling primarily filters, some process equipment, and failed in-cell cranes and powered manipulators
- Providing fixtures for holding components while doing work
- Operation of some manual valves
- Decontamination and monitoring of contaminated equipment

Typical ventilation equipment the PFH system will handle are High Efficiency Particulate Air Filter (HEPA) and High-Efficiency Mist Eliminators (HEMEs), and duct isolation valves, inside the cell. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors

- Crane deployed equipment, such as impact wrenches and spreader bars
- Decontamination equipment (carbon dioxide, wash down)
- Manipulator-deployed assembly/disassembly tools used in repair

Radioactive Solid Waste Handling (RWH) System
The purpose of this system is to provide a means to dispose of mixed waste contaminated equipment. This system interfaces with system PIH, system PFH, and the spent resin dewatering system. The main functions system RWH provides are:

- Lifting, holding, and transporting disposal containers
- Packaging disposal containers and preparing the containers for shipping
- Cleaning and remote monitoring of disposal containers
- Temporary shielding and confinement barriers

Typical process and ventilation equipment the system will handle are failed process equipment, such as pumps and valves, filters, jumpers, and maintenance equipment.

Equipment in this system will include:

- Overhead cranes
- Manipulators (manual)
- Carts for transporting waste containers
- Associated support equipment, like impact wrenches and spreader bars
- Decontamination systems, such as carbon dioxide
- Remote radioactive monitoring
- Temporary shielding and confinement barriers used for packaging
- Disposal containers

The primary design features of the PIH, PFH, and RWH systems are:

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~~The pretreatment plant will include a maintenance facility that will enable remote and hands-on maintenance of wet process equipment, and will consist of the following systems.~~

- ~~Pretreatment In-Cell Mechanical Handling System (PIH)~~
- ~~Pretreatment Filter Cave Handling System (PFH)~~
- ~~Radioactive Solid Waste Handling System (RWH)~~

The individual systems and their primary functions are described below:

Pretreatment In-Cell Mechanical Handling System (PIH)
The purpose of this system is to provide a method for performing maintenance on process equipment in the process gallery hot cell. The equipment in the system will perform the following functions:

- Lifting, holding, transporting, installing/uncoupling process equipment and failed in cell cranes and powered manipulators
- Decontamination and monitoring to contaminated equipment
- Providing fixtures for holding components while doing work
- Disassembling, repairing, and reassembling failed contaminated process equipment remotely

Typical process equipment that the system will handle are pumps, valves, jumpers, small vessels, and ancillary equipment and/or tools. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools from the radioactive solid waste handling system.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Size reduction equipment (cutters, shears, etc.)
- Associated support equipment, like impact wrenches and spreader bars
- Retrieval docking mechanism
- Fixtures
- Fasteners
- Decontamination equipment (carbon dioxide, wash down, flushing, dunk tank)
- Assembly/disassembly tools used in repair: these tools will be used by only the manipulators

Pretreatment Filter Cave Handling System (PFH)
The purpose of this system is to provide a method for performing maintenance on ventilation equipment in the filter cave hot cell. The equipment in this system will provide the following functions:

- Lifting, holding, transporting, installing/uncoupling primarily filters, some process equipment, and failed in-cell cranes and powered manipulators
- Providing fixtures for holding components for while doing work
- Operation of some manual valves
- Decontamination and monitoring to contaminated equipment
- Size reduction equipment (filter crushing)

Typical process equipment the PFH will handle are HEPA and high efficiency mist eliminator filters, and valves, inside the cell. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Associated support equipment, like impact wrenches and spreader bars
- Retrieval docking mechanism
- Fixtures
- Fasteners
- Decontamination equipment (carbon dioxide, wash down)
- Assembly/disassembly tools used in repair: these tools will be used by only the manipulators

Radioactive Solid Waste Handling System (RWH)
The purpose of this system is to provide a means to dispose of radioactive contaminated equipment. This system interfaces with in-cell handling, filter cave handling, and the spent resin dewatering system. The main functions the RWH provides are:

- Lifting, holding, transporting, disposal containers
- Packaging disposal containers and preparing the containers for shipping
- Decontamination of waste and cleaning and remote monitoring of disposal containers
- Temporary shielding and confinement barriers

Typical process equipment the system will handle are failed process equipment, such as pumps and valves, filters, jumpers, and maintenance equipment.

Equipment in this system will include:

- Overhead cranes
- Manipulators (manual)
- Carts for transporting waste containers
- Associated support equipment, like impact wrenches and spreader bars
- Decontamination systems, such as carbon dioxide and dunk tanks
- Fixtures
- Remote radioactive monitoring
- Temporary shielding and confinement barriers used for packaging
- Disposal containers

4.1.2.15 Plant Wash and Disposal (PWD) System

Figure 4A-17 presents a simplified process flow diagram of the Plant Wash and Disposal (PWD) System. The primary function of the PWD tank system is to receive, store, and transfer effluent. It will collect plant wash, drains, and acidic or alkaline effluent from the pretreatment plant.

The primary components of the PWD tank system include:

- C3 Floor Drain Collection Vessel (PWD-VSL-00046)
- Acidic/Alkaline Effluent Vessels (PWD-VSL-00015/16)
- Plant Wash Vessel (PWD-VSL-00044)
- HLW Effluent Transfer Vessel (PWD-VSL-00043)
- Ultimate Overflow Vessel (PWD-VSL-00033)
- Pumps, piping, and instrumentation for waste transfers

Plant Wash Vessel (PWD-VSL-00044)
During operations, plant wash and drain effluents will be collected and mixed in with other effluents in the Plant Wash Vessel prior to transfer. The solution will be analyzed for pH and excess acidic effluent will be neutralized. Effluents will be recycled to the FEP system.

Pulse jet mixers are used to provide a uniform mixture during neutralization within the Plant Wash Vessel. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent header. Wash rings are used for vessel washing. Vessel-emptying ejectors may be used for transfers to the Acidic/Alkaline Effluent Vessels (PWD-VSL-00016).

A reverse flow diverter supplies a representative sample of the contents of the Plant Wash Vessel (PWD-VSL-00044) for analysis. If the pH is confirmed to be above a predetermined value, reverse flow diverter(s) transfer the effluent from the Plant Wash Vessel (PWD-VSL-00044) to the Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B). Normally, the contents of the Plant Wash Vessel i blended with the contents of the Acidic/Alkaline Effluent Vessels (PWD-VSL-00015/16) in the Waste Feed Evaporator Feed Vessels to maintain a consistent evaporator feed.

Acidic/Alkaline Effluent Vessels (PWD-VSL-00015/16)
The Acidic/Alkaline Effluent Vessels primarily receive alkaline cleaning effluent from the UFP system, caustic rinse from the Cesium Ion Exchange Process (CXP) System, and process condensate from the Cesium Nitric Acid Recovery Process (CNP) System. The effluents are sampled to confirm that the pH is above a predetermined value, and reverse flow diverters transfer the high-activity effluents to the Waste Feed Evaporator Feed Vessels (FEP-VSL-00017A/B) for reprocessing.

HLW Effluent Transfer Vessel (PWD-VSL-00043)
The HLW Effluent Transfer Vessel receives HLW acidic wastes from HLW vitrification line drains from HLW vitrification/pretreatment plant transfer lines, and laboratory drains. The vessel may also receive flush wastes from the HLW plant. These effluents are transferred to the Plant Wash Vessel (PWD-VSL-00044) to recycle the effluents back into the process system.

C3 Floor Drain Collection Vessel (PWD-VSL-00046)
The C3 Floor Drain Collection Vessel receives effluents from miscellaneous floor drains in the C3 areas, and liquids from the sump in the local pit. Sampling capability has been provided but will not normally be used. This effluent will be transferred to the Alkaline Effluent Vessels (RLD-VSL-00017A/B). The C3 Floor Drain Collection Vessel (PWD-VSL-00046) is vented locally through a high-efficiency particulate air filtration system.

Ultimate Overflow Vessel (PWD-VSL-00033)
The Ultimate Overflow Vessel receives overflows from vessels in the pretreatment plant. Additionally, this vessel receives line drains and flushes. The vessel operating level is maintained below a predetermined level to allow the vessel to hold 30 minutes of overflow at the highest transfer rate within the plant.

The primary design features of the PWD system are:

- Instrumentation for monitoring and control of vessel liquid level.
- Pulse jet mixers in the Ultimate Overflow Vessel (PWD-VSL-00033), the HLW Effluent Transfer Vessel (PWD-VSL-00043), the Acidic/Alkaline Effluent Vessels (PWD-VSL-00015/16), and the Plant Wash Vessel (PWD-VSL-00044).
- Passive vessel overflow routes from the Acidic/Alkaline Effluent Transfer Vessels, and the Plant Wash Vessel.

- Remote sampling capabilities on the discharge of transfer pumps.
- Connection of the vessel vapor spaces to the Pretreatment Vessel Vent Process (PVP) System.

The primary function of the PWD is to receive, store, and transfer effluent. It will collect plant wash, drains, and acidic or alkaline effluent from the pretreatment plant.

The primary components of the PWD include:

- Alkaline effluent vessels (V15013 and V15018)
- Plant wash vessel (V15009A)
- Primary and secondary acidic/alkaline effluent vessels (V45013 and V45018)
- C3 drain collection vessel (V15319)
- HLW effluent transfer vessel (V12002)
- Ultimate overflow vessel (V15009B)

Plant Wash Vessel
During operations, plant wash and drain effluents will be collected and mixed in with other effluents in the plant wash vessel prior to transfer. The solution will be analyzed for pH and excess acidic effluent will be neutralized. Effluents will be recycled to the waste feed evaporation process system (FEP).

The level, temperature, and pH in the plant wash vessel, as well as the temperature in each of the ten plant wash breakpots, are monitored in the central control room. Pulse jet mixers are used to provide a uniform mixture during neutralization within the plant wash vessel. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent bulge. Wash rings are used for vessel and breakpot washing. Vessel-emptying ejectors may be used for transfers to the secondary acidic/alkaline effluent vessel via a breakpot.

A reverse flow diverter supplies a representative sample of the contents of the plant wash vessel for analysis. If the pH is confirmed to be approximately 12 or above, reverse flow diverters transfer the effluent from the plant wash vessel to the evaporator feed vessels (V11001A or V11001B). Normally, the contents of the plant wash vessel has priority over the primary and secondary acidic/alkaline effluent vessels when transferring effluent to the FEP contents of the s.

The plant wash vessel, as well as the breakpots, vent to PVP, via a vessel vent scrubber and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the plant wash vessel.

Acidic/Alkaline Effluent Vessels

High-activity acidic and alkaline effluent is received, stored, and neutralized in the primary acidic/alkaline effluent vesselor the secondary acidic/alkaline effluent vessel prior to transfer. The primary and secondary acidic/alkaline effluent vessels will receive wastes from those sources listed on the process flow figures in Appendix 4A.

In both vessels, the acidic and alkaline effluents will be mixed to neutralize the effluents. The mixture will be analyzed and neutralized, if necessary. When the effluent meets the predetermined pH value, it will be transferred to the FEP, for recycling.

The system vessels are designed to withstand the anticipated heat of reaction generated by mixing the effluents. Normally, only low concentrations of acidic and caustic solutions will be mixed during operations, keeping the temperature within design limits. Higher concentrations of acidic and caustic effluents may be mixed during operations, with a greater increase in heat generation. The system will monitor temperature rise in the vessels and will automatically stop the effluent receipt when the temperature reaches a predetermined set point within design limits.

The level, temperature, and pH in the primary and secondary acidic/alkaline effluent vessels as well as the temperature in each of the primary acidic/alkaline effluent breakpots and the secondary acidic/alkaline effluent breakpot, are monitored in the central control room. Pulse jet mixers are used to provide a uniform mixture during neutralization within these vessels. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent bulge. Wash rings are used for vessel and breakpot washing. A vessel-emptying ejector may be used for transfers to the plant wash vessel.

Reverse flow diverters supply a representative sample of the contents of the primary and secondary acidic/alkaline effluent vessels for analysis. If the pH is confirmed to be approximately 12 or above, reverse flow diverters transfer the HLW effluent from the primary and secondary acidic/alkaline effluent vessels to the FEP vessels.

Alkaline Effluent Vessels

The # effluent vessels primarily receive caustic scrubber purge from LAW vitrification and effluents from the TXP. The effluents are sampled, and if they meet acceptability requirements, they are sent to RLD. If it does not meet the requirements, the effluent is sent to the TLP ity/B).

The level, conductivity, radioactivity, and pH in the # effluent vesselsare monitored in the central control room.

C3 Drain Collection Vessel

The C3 drain collection vessel receives floor drains and floor sumps from C3 areas. The effluents are transferred to the plant wash vessel for treatment.

HLW Effluent Transfer Vessel

The HLW effluent transfer vessel receives HLW acidic wastes from HLW vitrification line drains from HLW vitrification/pretreatment plant interface lines, and laboratory drains. These effluents can be transferred to the plant wash vessel to recover the effluents back into the process system.

This

Ultimate Overflow Vessel

The ultimate overflow vessel receives overflows from vessels in the pretreatment plant. Additionally, this vessel receives line drains and flushes. The vessel operating level is maintained below a predetermined level to allow the vessel to hold 30 minutes of overflow at the highest transfer rate within the facility.

The PWD vessels, as well as the breakpots, vent to the PVP via a vessel vent scrubber and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the PWD vessels.

Instrumentation, alarms, controls, and interlocks will be provided for the PWD indicate or prevent the following conditions:

- Overfilling. Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment. Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Inadvertent transfers of fluids. System sequential transfer operations are interlocked.

4.1.2.16 Radioactive Liquid Waste Disposal (RLD) System

Figure 4A-18 presents a simplified process flow diagram of the Radioactive Liquid Waste Disposal (RLD) System. The primary function of the RLD tank system is to receive, store, and transfer contaminated liquid effluents. The RLD system will receive low-activity mixed waste effluents.

The primary components of the RLD tank system include:

- Process Condensate Tanks (RLD-TK-00006A/B)
- Alkaline Effluent Vessels (RLD-VSL-00017A/B)
- Pumps, piping, and instrumentation for waste transfers

These RLD vessels primarily receive effluent from the caustic scrubber purges from the LAW vitrification plant and from the C3 Floor Drain Collection Vessel in PTF (PWD-VSL-00046).

When these vessels reach a predetermined level, they are sampled, and if the sample meets the LERF/ETF waste acceptance criteria, it will be transferred to the Process Condensate Tanks (RLD-TK-00006A/B). If the effluent does not meet LERF/ETF waste acceptance criteria, it will be returned to the Treated LAW Evaporation Process (TLP) System for reprocessing.

Process Condensate Tanks (RLD-TK-00006A/B)
Process condensates are the effluent condensed vapors removed from the waste streams by the PTF evaporators. Waste Feed Evaporator Feed Process (FEP) effluents and Treated LAW Evaporation Process (TLP) condensates are normally received directly into the Process Condensate Tanks (RLD-TK-00006A). The effluents from the Process Condensate Tank (RLD-TK-00006A) are recycled into the process or discharged to the Process Condensate Tank (RLD-TK-00006B).

The effluent in the Process Condensate Tanks will be sampled, to demonstrate compliance with the LERF/ETF waste acceptance criteria. It may also be sampled should a process upset occur. If analysis determines that the effluent is outside the waste acceptance criteria, it will be returned to the TLP for reprocessing.

The Alkaline Effluent Vessels (RLD-VSL-00017A/B) and Process Condensate Tanks (RLD-TK-00006A/B) are vented to the PVP system.

The primary design features of the RLD system are:

- Instrumentation for monitoring and control of vessel liquid level.
- Passive vessel overflow routes from the Alkaline Effluent Vessels (RLD-VSL-00017A/B).
- Remote sampling capabilities on the discharge of transfer pumps.
- Connection of the vessel vapor spaces to the Pretreatment Vessel Vent Process (PVP) System.

~~The primary function of the RLD system is to receive, store, and transfer contaminated liquid effluents. The RLD will receive low-activity radioactive and/or dangerous waste effluents.~~

~~The primary components of the RLD include:~~

- ~~Two process condensate vessels (V45028A and V45028B)~~
- ~~Pumps, piping, and instrumentation for transfers~~

The RLD primarily receives effluent from the caustic scrubber purges from the LAW vitrification plant via the PWD, FEP, and the TLP. These effluents are the condensed vapors removed from the waste streams. Liquid effluents from the systems will be recycled or discharged to the Hanford Site LERF and then transferred to the ETF.

Prior to transfer to the LERF/ETF, the effluent will be sampled to assure compliance with the waste acceptance criteria of the facility. If analysis determines that the effluent is outside the waste acceptance criteria, it will be returned to the PWD for reprocessing.

Clean condensates may also be routed back to the pretreatment plant as process water makeup. Alternatively to discharging to the RLD, effluents from the pretreatment plant that are not radioactively contaminated and that designate as dangerous waste may be transferred to the NLD.

Vessels in the RLD system will be vented to the PVP.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Inadvertent transfers of fluids: System sequential transfer operations are interlocked.

4.1.2.17 Pretreatment Plant Vessel Vent Process and Exhaust (PVP/PVV) System

The pretreatment plant off-gas treatment systems consist of the following major systems:

- Pretreatment Vessel Vent Process System (PVP)
- Process Vessel Vent Extraction (PVV)

The PVP will treat two off-gas streams. One stream will be from pretreatment vessel vents (tanks and other vessels), and the other stream will be exhaust from reverse flow diverters and pulsejet mixers. Both off-gas streams will be collected and treated separately within the PVP. Following treatment in the PVP, the off-gas streams will

~~proceed to the PVV where the streams will be sampled and discharged through separate flues within the pretreatment plant stack.~~

~~The functions of the PVP are to remove solids, liquid droplets, and mists from the off-gas; prevent condensation in the HEPA filters; absorb soluble gases; and treat volatile organic gases. The ventilation systems upstream and downstream of the PVP are important to, and integral with, the functioning of the PVP. Upstream of the PVP will be an air inlet system that regulates air in-bleed rates to each process vessel. The motive force is provided by the ventilation fans downstream of the vessel vent system. The PVP, in combination with upstream and downstream systems, provides the radiolytic hydrogen control strategy for the pretreatment plant. The PVV will maintain continuous operation to provide the hydrogen control function, and will use backup power generators for the exhaust fans.~~

~~The off-gas streams flow through a network of subheaders (piping) to two major collection headers. The two off-gas streams will be separated because the reverse flow diverter/pulse jet mixer exhaust stream will have a much higher flow rate with a significantly lower concentration of radionuclides and volatile constituents then the vessel ventilations. Separating these two air streams will allow better control of pressures and exhaust airflow rates, as well as minimizing the size of emission abatement equipment (volatile organic compounds oxidation unit, carbon beds, and scrubber).~~

~~The PVP will include a caustic scrubber, high efficiency mist eliminator (high efficiency mist eliminator), a volatile organic compounds oxidation unit, and carbon bed adsorbers. The reverse flow diverter/pulse jet mixer off-gas is treated through a high efficiency mist eliminator before going to the PVV. After treatment in the PVP, both treated off-gas streams will proceed, separately, to the PVV. The extract system for both streams includes a hot air injection system with electric heating coils and backflow HEPA filters. Downstream of the hot air injection the PVV includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. Although the volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.~~

~~The following sections provide descriptions of the PVP components:~~

- ~~Vessel vent header collection vessel (V15052)~~
- ~~Condensate collection vessel (V15038)~~
- ~~Two high efficiency mist eliminator drain collection vessels (V15326 and V15327)~~
- ~~Air inlet (air purge system)~~
- ~~Collection (exhaust piping system)~~
- ~~Vessel vent caustic scrubber~~
- ~~High efficiency mist eliminators and pre-heaters~~

- Volatile organic compounds oxidation unit
- Carbon bed adsorbers

Air inlet (air purge system)
Because the pretreatment process system design is an airtight design, the overall gas exhaust flow (except for evaporation, boiling, etc.) is directly dependent on the air purge rates provided to each individual process vessel.

Continuous air purge to process vessels is the primary control strategy for radiolytic produced hydrogen. Additional airflow above the minimum hydrogen control rate may be introduced to each vessel to help balance the system and ensure that vessels are obtaining the minimum required flow. Additional airflow above the minimum for hydrogen dilution will also be introduced to individual vessels to remove heat by evaporative cooling. This function will help prevent boiling of self-heating tanks during an extended shutdown.

The air inlet header system is fitted with HEPA filters, isolation valves (to change HEPA filters if needed), balance and control valves to regulate flow, and a flow measurement device. Each inlet header will obtain air, at atmospheric pressure, from a C3 area and flow to a group of tanks supplied by that subheader. The supply lines are designed for the desired balance and total flow regulated at the inlet by the valves. The HEPA filters protect the C3 area from contamination in the event of reverse airflow, but airflows and balance will be designed to prevent reverse flow. The air inlet headers will supply air to groups of vessels, initially each process cell. The supply air arrangement will be independent of the exhaust air gathering system.

Collection (exhaust piping system)
From the individual process vessels a vent line routes exhaust gases to a subheader, usually one for each cell or group of vessels within a cell. The connection to the subheaders from the process vessels are arranged, where possible, to maintain airflow from normally lower activity vessels to (or past) normally higher activity levels vessels. This will help prevent contamination of lower activity vessels due to potential reverse flow, or in-breathing. The subheader locations and the overall flow scheme will also be influenced by the plant layout and by the physical location of the major vessel vent headers.

Final sizing of the individual exhaust vent lines will be determined by airflow, process pump capacities for filling vessels, and other potential pressurization scenarios. The individual exhaust vent lines, the subheaders, and the headers will also be sized to minimize overall pressure drop and help balance the system.

Vessel Vent Caustic Scrubber
The vessel vent exhaust streams will be collected for treatment in the caustic scrubber. The scrubber removes radioactive aerosols, acid gases, and NO_x emissions. The caustic

~~scrubber will be a column with a bed filled with packing material. Sodium hydroxide solution flows down through the bed while the off-gas enters the bottom and is drawn up through packing and caustic solution. Contact between the gas and the liquid in the bed causes a portion of the NO_x in the vent gas to dissolve and form sodium nitrate. The scrubbing liquor collects in the sump of the column, and excess overflows to pretreatment effluent collection.~~

~~The caustic scrubber solution is recirculated by a pump. A pipe from the base of the scrubber leads to the pump suction and returns liquid to the column above the top of the packing. Above this point there is another packed section with very fine packing rings that acts as a disentrainment section to prevent caustic loss. There is a water wash ring above the disentrainment section in the column to wash accumulated caustic solid off the packing. Fresh caustic is supplied to the unit by a metering pump from the reagents system.~~

~~Demineralized water will be added to the scrubber, when needed, through the wash rings. Excess recirculation solution from the scrubber will be routed to pretreatment effluents. After leaving the scrubber, the off-gas flows to the high efficiency mist eliminators. Positioning the scrubber ahead of the high efficiency mist eliminators saturates the gas flow and enables the high efficiency mist eliminators to avoid damage from dry operation. The scrubber is provided with a bypass line and valve. The bypass function is to permit continued operation of the hydrogen control system in the unlikely event the scrubber becomes plugged or disabled, or during maintenance activities.~~

~~The vessel vent caustic scrubber generates the liquid purge stream based on the absorption and cooling of the incoming vent exhausts from various vessels in the pretreatment plant. The vessel vent scrubber recirculation pump transfers, by batch, the scrubbing liquid purge stream once a day to the PWD. The scrubbing liquid purge stream transfers the accumulated condensate, radiolytic particulates and salts from the recirculating scrubbing liquid stream in the vessel vent scrubber.~~

~~High Efficiency Mist Eliminators and Pre-heater~~

~~The high efficiency mist eliminator will be composed of regenerable deep-bed fiber filters configured in an annular shape to remove fine aerosols. Gas flows from the outside to the inside hollow core, where the treated gas exits at the top and the liquid collects at the sealed bottom in a drainpipe. The high efficiency mist eliminator will operate wet so that as the liquid aerosols accumulate they form a liquid film on the filter element, which then drops to the drain. Intermittent water spraying of the filter elements will be used to treat the vessel vent off-gas stream.~~

~~Three separate high efficiency mist eliminators will treat the vessel vent off-gas streams. The pulse jet mixer/reverse flow diverter has four separate high efficiency mist eliminators, three in-service, and one offline. This configuration will permit washing~~

each high efficiency mist eliminator while it is offline. The high efficiency mist eliminator effluent will be discharged to a drain vessel and then to an effluent vessel.

After treatment in a high efficiency mist eliminator, the vessel ventilation off-gas stream will be heated by the hot air injection system. The hot air injection system draws air through HEPA filters from a C3 area. The air is heated with an electric inline heater so that the combined air stream will be above its dewpoint to prevent condensation in the PVV HEPA filters. The HEPA filters in the hot air injection line protect against backflow of contamination into the C3 area and protect the heaters from contamination for maintenance.

The hot air injection system begins the PVV; it also includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. The volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, but they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.

Volatile Organic Compound Oxidation Unit

To remove volatile organics compounds and in the vessel vent stream, a catalyst skid mounted unit with a thermal catalytic oxidizer unit will be used. In this unit, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream).

As the off-gas enters the unit, it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the thermal catalytic oxidizer unit. The cool off-gas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalyst to operate.

Oxidation of organic compounds is an exothermic reaction therefore it significantly increases the off-gas temperature. This hot off-gas then enters the hot side of the heat recovery unit to heat the incoming off-gas. The cooled off-gas stream is then directed to the carbon bed adsorbers for further volatile organic compounds treatment.

Carbon Bed Adsorbers

Two parallel carbon beds are provided in the design. The carbon beds will further reduce volatile organic compounds from the vessel vent off-gas stream. The volatile organic compounds oxidation unit is designed to remove most of the volatile organic compounds from the vessel vent and the carbon beds will remove the remaining volatile organic compounds. A bypass line and valve is included in the event both units are out of service or are not needed. Normal operation will be one unit online while the other is in maintenance and regeneration mode.

Typical safety design features included in the PVP/PVV are as follows:

- ~~The cell will be lined and provided with a washing system for decontamination purposes~~
- ~~The cell will be provided with a shielded access plug to allow the use of observation equipment~~
- ~~The design of the vessel vent lines will take into consideration the hydrostatic level (to prevent liquid from entering the system)~~
- ~~The collection piping conveying vent system off-gases from the vessel vents, reverse flow diverters, and pulse jet mixers will be designed and routed in accordance with a process piping design guide~~
- ~~Traps will be fitted with water flush capability in order to clear potential line blockages~~
- ~~The local drainage sump will have an alarm/start set point to prevent flooding~~

Figure 4A-19 presents a simplified process flow diagram of the Pretreatment Plant Vessel Vent Process and Exhaust (PVP/PVV) System. The Pretreatment Vessel Vent Process (PVP) System and Exhaust (PVV) system provide the function of air purging of the head spaces of various process vessels for radiolytic hydrogen control, collection of vent exhausts from process vessels, and process treatment and filtration of the vessel vent exhaust gases before discharging to the PTF stack.

The PVP and PVV systems are composed of tanks and miscellaneous treatment systems, as follows:

Tank System

- Vessel Vent HEME Drain Collection Vessel (PVP-VSL-00001)
- Pumps, piping, and instrumentation for waste transfers

Miscellaneous Unit Systems

- Caustic Scrubber (PVP-SCB-00002)
- High-Efficiency Mist Eliminators (PVP-HEME-00001A/B/C)
- ~~Air in-bleed HEPA Filters (PVP-HEPA-000023/24/28/29/30/31/32/33/34/35)~~
- Primary High-Efficiency Particulate Air Filters (~~PVP~~PVV-HEPA-00001A/B)
- Secondary High-Efficiency Particulate Air Filters (PVV-HEPA-00002A/B)
- Volatile organic compound (VOC) Oxidizer Unit (PVP-OXID-00001)
- After-Cooler (PVP-CLR-00001)
- Carbon Bed Adsorbers (PVP-ADBR-00001A/B)
- Adsorber Outlet Filter (PVP-FILT-00001)
- Pumps, piping, and instrumentation for waste transfers
- Exhaust Fans (PVV-FAN-00001A/B)

- PVV stack(s)

Purge air supply
Continuous air purge to process vessels is the primary control strategy for radiolytic produced hydrogen. Additional airflow above the minimum hydrogen control rate may be introduced to each vessel to help balance the system and ensure that vessels are obtaining the minimum required flow.

The purge air in-bleed to vessels in the pretreatment area is a passive feature. The process vessels located in the C5 ventilation area will draw passive purge air in-bleed from the C5 ventilation area near the vessels via subheaders. Other vessels located in the C3 ventilation area and Process Condensate Tanks (RLD-TK-00006A/B) located outside the pretreatment building will draw air in-bleed from the C3 ventilation area nearest to the vessels through the inlet HEPA filters. The exhaust fans provide the motive force for airflow through each vessel by maintaining a negative pressure .

Forced purge air to the selected process vessels is also provided from the plant service air supply header. Each of the selected process vessels is provided with the required airflow to control the hydrogen concentration below 1% in the vessel during normal operation and below 4 % (lower flammability limit) during abnormal conditions. The supply line to each of these selected process vessels, which requires forced purge air during normal operation, is provided by two parallel trains of valves and flow elements to meet the high reliability requirements.

For the Waste Feed Evaporator Separator Vessels (FEP-SEP-00001A/B) and the Treated LAW Evaporator Separator Vessel (TLP-SEP-00001), which require forced purge air only during a shutdown or a loss of off-site power event, there are two separate trains of actuated valves and flow elements provided for each. The actuated valves for both of these trains are normally in closed position, but will fail open during the shutdown or loss of off-site power event.

Collection of vent gases (exhaust piping system)
From the individual process vessel, a vent line routes exhaust gases to a subheader, usually one for each cell. The connection to the subheaders from the process vessels are arranged, where possible, to maintain airflow from normally lower activity vessels to (or past) normally higher activity level vessels. Vent exhaust gases from various process vessels are combined to flow via subheaders to the Caustic Scrubber (PVP-SCB-00002). The vent gases from the vessels located in the C3 areas and the Process Condensate Tanks (RLD-TK-00006A/B), located outside the pretreatment building, will be collected via other subheaders that combine into the common exhaust header. Any condensate formed in the common exhaust header will flow by gravity into Plant Wash Vessel (PWD-VSL-00044).

Vessel Vent Caustic Scrubber (PVP-SCB-00002)
The vessel vent exhausts flow into the Caustic Scrubber. The Caustic Scrubber is operated continuously to remove the nitrogen oxide and acid gases from the vessel vents. The vent gases flow to the inlet of the scrubber and flow upwards through a packed bed. Alkaline scrubbing liquid flows down through the packed bed. Contact between the gas and the scrubbing liquid in the bed causes part of the nitrogen oxide and acid gases present in the vent offgases to react with the caustic in the scrubbing liquid and to adsorb and form sodium salts, which stay in solution. The scrubbing liquid solution is collected in the scrubber sump vessel located below the packed bed section of the scrubber.

Two scrubber recirculation pumps (one operating and one in standby) continuously recirculate the scrubbing liquid solution to the top of the packed bed section of the scrubber. The operating pump also directly recirculates part of the solution into the sump vessel located below the scrubber to provide adequate mixing of the liquid in the vessel. The scrubber pump also transfers the collected condensate and scrubbing liquid normally once a day or on high level to the Plant Wash Vessel (PWD-VSL-00044). A section of dry packing located above the main packed section removes any entrained liquid droplets from the exit gases. A wash-water ring is provided above each of the packed sections to wash off any accumulation of solids. Fresh five molar caustic solution is added intermittently from the sodium hydroxide reagent process system (SHR). The caustic solution is added intermittently to scrubber sump vessel to maintain the pH range for the scrubbing liquid recirculating to the top of the main packed section.

When needed, demineralized water is also added to the Caustic Scrubber wash rings to clean the dry packing or for makeup requirements.

The outlet gases from the Caustic Scrubber (PVP-SCB-00002) flow to the HEMEs. The inlet, outlet, and bypass valves are provided for the Caustic Scrubber. The valves will be remotely operated by a manipulator in the pretreatment filter cave area.

High-Efficiency Mist Eliminators and Pre-heater (PVP-HEME-00001A/B/C)
The HEMEs will be composed of deep-bed fiber filter elements configured in an annular shape to remove fine aerosols. Vent gases from the scrubber flow into two HEMEs, with the third HEME available as standby. Gases flow from the outside to the hollow core. The treated gas exits at the top and the liquid collects at the sealed bottom in a drainpipe. The HEMEs are operated wet at all times to allow drainage of soluble liquid aerosols that accumulate in the fibers, form a liquid film, and drop to the drain line below to the Vessel Ventilation HEME Drain Collection Vessel (PVP-VSL-00001). Atomizing spray of demineralized water is provided at the gas inlet nozzle for each operating HEME. An intermittent wash spray of the filter elements will be used to remove any accumulated debris, thus extending the service life of the HEME elements. Intermittent washing will normally be carried out off-line.

Three separate HEMEs will treat the vessel vent offgas stream. This configuration will permit washing each HEME while it is offline. The HEME effluent will be discharged to the Vessel Vent HEME Drain Collection Vessel (PVP-VSL-00001) and then to the Plant Wash Vessel (PWD-VSL-00044) in the PWD system.

After treatment in HEMEs, heated air is added from the inbleed HEPA filters to prevent condensation in the downstream PVV HEPA filters.

The PVV system also includes HEPA filters, exhaust fans, and the exhaust stack. The VOC Oxidation Unit (PVP-OXID-00001) and the Carbon Bed Adsorbers (PVP-ABS-00001A/B) will be part of the PVP system, which is located between the HEPA filters and the exhaust fans.

Primary HEPA Filters (PVV-HEPA-00001A/B/C)
The preheated vent exhaust gases from the heaters flow into one of the three Primary HEPA filters, which will be on line while the other two are available as standby offline. The HEPA filter will remove the particulates from the gas stream. The Primary HEPA Filters will be located in the pretreatment filter cave area (room P-0335) for remote maintenance.

Secondary HEPA Filters (PVV-HEPA-00002A/B/C)
The gases from the Primary HEPA Filter flow into one of the three Secondary HEPA Filters, which will be on line while the other two are available as standby offline. The Secondary HEPA Filter will remove the particulates from the exhaust gases.

After the Primary and Secondary HEPA Filters remove the particulates from the vessel vent exhaust stream in the PVV system, the filtered vent exhaust stream returns to the PVP system for abatement of volatile organic compounds. The volatile organic compound abatement process removes vapor-phase organic compounds from the PVP vent gas. This abatement process takes place within an oxidation system followed by an adsorption system. The oxidation system includes a VOC Oxidizer Unit (PVP-OXID-00001) and an After-Cooler (PVP-CLR-00001). The adsorption system includes Carbon Bed Adsorbers (PVP-ADBR-00001A/B) and a medium efficiency Adsorber Outlet Filters (PVP-FILT-00001A/B).

VOC Oxidizer Unit (PVP-OXID-00001)
To remove volatile organics compounds from the vessel vent stream, a skid-mounted electric, noncatalyzed oxidizer unit will be used. In this unit, volatile organic compounds are oxidized to carbon dioxide and water vapor at high temperature in the presence of excess oxygen.

The VOC Thermal Oxidizer will be a vendor-designed unit suitable for this specific application. By virtue of its heat recovery scheme, the unit is classified specifically as a regenerative thermal oxidizer. The oxidizer system will consist of three heat transfer

beds, electric heat elements within the reaction section, and a downstream trim cooler (after-cooler). All high-temperature components of the system will be insulated to minimize heat losses.
Oxidation of organic compounds is an exothermic reaction; therefore, it significantly increases the offgas temperature. The offgas then enters the heat recovery unit to transfer the heat to the bed, which will then be used for preheating the incoming offgas. The cooled gas stream is then directed to the After-Cooler (PVP-CLR-00001). The treated gases are cooled by the cooling water. Any condensate generated by cooling of the gases will flow to the C3 Floor Drain Collection Vessel (PWD-VSL-00046).

Carbon Bed Adsorbers (PVP-ADBR-00001A/B)
Two parallel Carbon Bed Adsorbers are provided for the final treatment of vent gases. The adsorbers are filled with activated carbon. The adsorber will further reduce volatile organic compounds from the vessel vent exhaust gases. The VOC Oxidizer Unit (PVP-OXID-00001) will remove most of the volatile organic compounds from the vessel vent gases, and the Carbon Bed Adsorbers (PVP-ADBR-00001A/B) will remove the remaining volatile organic compounds. Normal operation will be one unit online while the other is in maintenance mode.

Adsorber Outlet Filters (PVP-FILT-00001A/B)
The treated gases from the Carbon Bed Adsorbers (PVP-ADBR-00001A/B) will flow into this filter, wherein fine carbon particles, if any are present in the vent gases, will be filtered. This filter is also provided with a bypass line and isolation valves to enable replacement of the filter.

Exhaust Fans (PVV-FAN-00001A/B)
After the filtration in the Adsorber Outlet Filter (PVP-FILT-00001A/B), the vent gases will flow into the Exhaust Fan in the PVV system. Two Exhaust Fans are provided. One will be in operation while the second one will be on standby. The Exhaust Fans provide the necessary motive force to extract the vent gases from the head spaces of various process vessels and provides for the required pressure drop through various treatment equipment in the PVP/PVV systems. The Exhaust Fans will maintain a constant suction pressure at the inlet to the Caustic Scrubber (PVP-SCB-00002). The Exhaust Fans (PVV-FAN-00001A/B) will have suitable speed control to accommodate variation in the vent gas flow rates from various vessels.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.2, the following will be provided for the PVP/PVV systems to indicate or prevent the following conditions:

- Purge air flow measurement:
  - Passive purge air flow rate will be measured for the process vessels including low flow alarm for each of these flow instruments.

- Forced purge air flow rate will be measured and low flow alarmed for the process vessels that require the control of hydrogen concentration. These instruments will have important-to-safety instrument function.

- For the HEMEs;
  - The outlet pressure, pressure drop, and the flow rates will be monitored and controlled.
  - Demineralized water supply for HEMEs will have monitoring for the inlet pressure and flow rates.
- For the HEPA filters, the pressure drop will be monitored and controlled within the required limits.
- For the VOC Oxidizer Unit (PVP-OXID-00001):
  - The thermal oxidizer reaction zone, the outlet temperatures, and the pressure drop will be monitored and controlled.
  - The oxidizer bypass valve cannot be opened unless the reaction zone temperature has been attained.
- For the carbon bed adsorber:
  - The pressure drop through the bed will be monitored and controlled.
  - The differential temperature across the carbon bed will be monitored.
- For the adsorber outlet filter, the pressure drop will be monitored and controlled.

The PVP and PVV systems have the following design features:

- Provide the function of air purging of the head spaces of various process vessels for radiolytic hydrogen control.
- Collect vent exhausts from process vessels
- Treat the combined exhaust gases to adsorb soluble nitrogen oxide(s) and acid gases, remove liquid droplets, condensate, mists, and solid particulates in the PVP system
- Preheat vent gases to control relative humidity and then remove particulates with two stages of High-Efficiency Particulate Air (HEPA) filters
- Provide additional treatment for the oxidation and removal of volatile organic compounds from the filtered exhaust gases in the PVP system. The filtered treated exhaust gases will then flow to the exhaust fans in the PVV system for venting to the atmosphere

4.1.2.18 Pulse Jet Ventilation (PJV) System

~~Pretreatment plant ventilation includes the following systems:~~

- ~~C1 Ventilation System (C1V)~~

- ~~C2 Ventilation System (C2V)~~
- ~~C3 Ventilation System (C3V)~~
- ~~C5 Ventilation System (C5V)~~

~~The primary consideration in the design of the ventilation systems is to confine airborne sources of contamination to protect human health and the environment from exposure to hazardous materials during normal and abnormal operating conditions. Physical barriers or structures supported by the ventilation systems will ensure that before air is released to the environment and residual contamination is well below acceptable, safe levels for public exposure.~~

~~The pretreatment plant will be divided into four numbered zones, listed below, with the higher number indicating greater radiological hazard potential that needs greater control or restriction. The ventilation system zoning is based on the classifications assigned to building areas for potential contamination. Zones classified as C5 are potentially the most contaminated, such as the pretreatment cells. Zones classified as C1 are uncontaminated areas.~~

~~The confinement provided by physical barriers is enhanced by the ventilation system, which creates a pressure gradient and causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential. There will be no C4 areas in the pretreatment plant. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence, the amount of air requiring treatment.~~

~~C1 Ventilation System (C1V)~~
~~C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.~~

~~C2 Ventilation System (C2V)~~
~~C2 areas typically consist of non-process operating areas, access corridors, and control/instrumentation, and electrical rooms. Filtered air will be supplied to these areas by the C2 supply system and will be cascaded into adjacent C3 areas or HEPA filtered and exhausted by the C2 Exhaust system.~~

~~C3 Ventilation System (C3V)~~
~~C3 areas normally will be unoccupied, but operator access during maintenance will be allowed. C3 areas typically will consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Access from a C2 area to a C3 area will be via a C2/C3 subchange room. Air will generally be drawn from C2 areas and cascaded through the C3 areas into C5 areas. In general, air cascaded into the C3 areas will be from adjacent~~

C2/C3 subchange rooms. In some areas, where higher flow may be required into C3 areas, a dedicated C2 supply will be provided with a backdraft damper on the C2 supply duct, which will be closed in the event of a loss of C3 extract. This system will shut down should there be a failure of the C5 Exhaust System.

C5 Ventilation System (C5V)

The pretreatment plant C5 areas are designed with the cell or cave perimeter providing radiation shielding as well as a confinement zone for ventilation purposes. C5 areas typically consist of a series of process cells where waste will be stored and treated. The pretreatment plant hot cell will house major pumps and valves and other process equipment. Air will be cascaded into the C5 areas, generally from adjacent C3 areas, and extracted by the C5 extract system. The C5 Exhaust System will be composed of Primary and Secondary HEPA filters and variable speed fans. Fans designed to maintain continuous system operation will drive the airflow. This system will also be interlocked with the C3 HVAC system, to prevent backflow by shutting down the C3 system if the C5 HVAC system shuts down.

Figure 4A-128 presents a simplified process flow diagram of the Pulse Jet Ventilation (PJV) System. The PJV system provides the safety function to treat the exhausts from reverse flow diverters and pulse jet mixers operating inside various process vessels before release to the atmosphere via the pretreatment plant stacks. The PJV system consists of process and HVAC equipment for removal of aerosols and particulates. The PJV system is composed of tanks and miscellaneous treatment systems, as follows:

Tank System

- PJV Drain Collection Vessel (PJV-VSL-00002)
- Pumps, piping, and instrumentation for waste transfers

Miscellaneous Unit Systems

- Demisters (PJV-DMST-00002A/B/C)
- Air In-Bleed Filters (PJV-FLTH-00001A/B)
- Electric Heaters (PJV-HTR-00001A/B)
- Air In-Bleed HEPA Filters (PJV-HEPA-00003A/B)
- Primary HEPA Filters (PJV-HEPA-00001A/B/C/D/E/F/G)
- Secondary HEPA Filters (PJV-HEPA-00002A/B/C/D/E/F)
- Exhaust Fans (PJV-FAN-00001A/B/C)
- Pumps, piping, and instrumentation for waste transfers

The PJV system provides the containment and confinement of exhausts from various reverse flow diverters and pulse jet mixers operating inside the PTF process vessels. This system provides the removal of mists and aerosols from the combined PJV exhausts stream by demisters (medium-efficiency mist eliminators). The treated exhaust gases are mixed with hot air in-bleed from the C3 ventilation area to adjust their relative humidity followed by two stages of HEPA filtration to remove particulates. The filtered effluent gases flow to the Exhaust Fans (PJV-FAN-00001A/B/C). The treated filtered exhaust stream will be monitored before it is discharged to the atmosphere.

Collection of Exhaust Gases (Exhaust Piping System)
The PJV system receives the exhaust via several subheaders from the reverse flow diverters and pulse jet mixers operating in various process vessels in the pretreatment area. The exhausts are combined from various subheaders to flow via the inlet header to the Demisters (PJV-DMST-00002A/B/C). The low points of the inlet header and subheaders are provided with drain lines, which drain condensate collected in the header to the PJV HEME Drain Collection Vessel (PJV-VSL-00002). This vessel is also provided with an overflow, which will flow to the Ultimate Overflow Vessel (PWD-VSL-00033) in the Pretreatment Plant Wash and Disposal (PWD) System. The condensate from the PJV HEME Drain Collection Vessel (PJV-VSL-00002) is periodically transferred by the drain transfer pumps to the Plant Wash Vessel (PWD-VSL-00044) in the PWD system.

Demisters (PJV-DMST-00002A/B/C)
The PJV system is provided with three Demisters (PJV-DMST-00002A/B/C), which are medium-efficiency mist eliminators. Two of these demisters are in service at a given time and one is available as a standby off-line.

Demisters are used to remove fine aerosols and mist, and exhibit medium removal efficiencies for submicron aerosols. They are passive devices with low maintenance requirements and high reliability. The demisters will adequately protect the HEPA filters, located downstream in this system, from excessive activity buildup, and provide the desired HEPA filter life of 4 to 5 years.

All Demisters (PJV-DMST-00002A/B/C) for this system are located, along with the HEPA filters, in the filter cave (room P-0335) in a C5 ventilation area due to the expected radionuclide loading. The Demisters (PJV-DMST-00002A/B/C) are either isolated, or put into service, by opening or closing isolation valves provided at the inlet and outlet of each Demister. These isolation valves are operated remotely by using the manipulator and the filter cave operating crane. The headers are designed without any bypass around the Demisters (PJV-DMST-00002A/B/C) to prevent the downstream HEPAs from accelerated loading of particulates. Remote change out capability for the Demister filter elements is provided.

The outlet gases from the Demisters (PJV-DMST-00002A/B/C) flow to the outlet header to the extract part of the PJV system, as described below.

Hot Air In-Bleed
Air in-bleed from a C3 ventilation area is filtered, heated, and then mixed with the exhaust gases from the Demister outlet to reduce the relative humidity of the stream flowing into the primary HEPA Filter banks. The in-bleed air is filtered with medium efficiency Air In-Bleed Filters (PJV-FLTH-00001A/B) and then heated to the temperature required to keep the humidity of the mixed gases below 70% and prevent the wetting of the HEPA Filters.

There are two Electric Heaters (PJV-HTR-00001A/B) arranged in parallel, one working and the other as standby, to provide the required heating of in-bleed air. Hot air in-bleed flows from the Electric Heaters to Air In-Bleed HEPA Filters (PJV-HEPA-00003A/B), one working and the other as standby. These provide protection against backflow of the PJV exhaust stream into the in-bleed system in the C3 ventilation area.

Primary Exhaust HEPA Filters (PJV-HEPA-00001A/B/C/D/E/F/G)
There are seven Primary HEPA Filter banks, arranged in parallel and configured in a running/standby arrangement to allow on-line filter change. There will be five Primary HEPA Filters in operation, and two Primary HEPA Filters will be on standby or in maintenance. The Primary HEPA Filters will be remote change type located in the pretreatment filter cave area. Filter inserts are radial type. Inlet and outlet isolation valves for the HEPA Filters are remotely operated by a manipulator and maintenance crane in the pretreatment filter cave (room P-0335).

Secondary HEPA Filters (PJV-HEPA-00002A/B/C/D/E/F)
Exhaust gases from the Primary HEPA Filters are routed to the outlet header, then to the Secondary HEPA Filters located in a C3 ventilation area. There are six Secondary HEPA Filter banks, arranged in parallel and configured in a running/standby arrangement to allow on-line filter change. There will be four Secondary HEPA Filters in operation, and two Secondary HEPA Filter banks will be on standby or in maintenance. Secondary HEPA Filters will be the safe change type.

PJV Exhaust Fans (PJV-FAN-00001A/B/C)
The filtered exhausts from the Secondary HEPA Filters will flow to three Exhaust Fans. Two fans will be in operation while the third fan will be on standby. The Exhaust Fans provide the necessary motive force to extract the vent gases from the fluidics discharge racks and provide for the required pressure drop through the treatment equipment in the PJV system. The Exhaust Fans (PJV-FAN-00001A/B/C) will maintain a constant suction pressure condition for the inlet gas stream to the Demisters. The Exhaust Fans will have suitable speed control to accommodate variation in the exhaust flow rates from reverse flow diverters and pulse jet mixers operating inside various vessels.

In the event of failure of one of the two Exhaust Fans in operation, the standby fan automatically starts. Each fan is provided with manual isolating dampers on the fan inlet and pneumatic actuated isolating dampers on the fan outlet. From the PJV Exhaust Fans, pulse jet mixer and reverse flow diverter treated effluents flow via a dedicated, continuously monitored flue to the PTF stack.

The PJV system has the following design features:

- Instrumentation for monitoring process flows and equipment performance
- Remote sampling system to confirm system performance.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.2, the following will be provided for the PJV system to indicate or prevent the following conditions:

- Flow rate for the combined exhaust gas entering the Demisters (PJV-DMST-00002A/B/C) will be monitored. Suction pressure for the inlet gas will be maintained by varying the speed for the Exhaust Fans (PJV-FAN-00001A/B/C)
- Pressure drop for the Demisters (PJV-DMST-00002A/B/C) will be monitored
- Each HEPA filter bank will be monitored and alarmed on high differential pressure

4.1.2.19 Sodium Hydroxide Reagent (SHR) System

The PTF sodium hydroxide reagent (SHR) system, located on elevation 98', includes a vessel (SHR-VSL-00001), ancillary equipment, and instruments associated with its operation. Sodium hydroxide is stored in vessel SHR-VSL-00001for emergency elution of the cesium ion exchange (CXP) columns. The vessel SHR-VSL-00001 receives sodium hydroxide from the BOF sodium hydroxide reagent storage vessel after dilution to 0.1 M using ionized water. When the high temperature alarm is detected on the CXP columns, the sodium hydroxide is gravity transferred from the SHR-VSL-00001 to the cesium ion exchange system.

The SHR system does not manage dangerous waste and is provided here for completeness of the PTF process description.

4.1.2.20 Pretreatment Plant Ventilation

Pretreatment plant ventilation includes the following systems:

- C1 ventilation system (C1V)
- C2 ventilation system (C2V)
- C3 ventilation system (C3V)
- C5 ventilation system (C5V)

The primary consideration in the design of the ventilation systems is to confine airborne sources of contamination to protect human health and the environment from exposure to hazardous materials during normal and abnormal operating conditions. Physical barriers or structures supported by the ventilation systems will ensure air released to the environment and residual contamination is well below acceptable, safe levels for public exposure.

The pretreatment plant will be divided into four numbered zones, listed below, with the higher number indicating greater hazard potential that needs greater control or restriction. The ventilation system zoning is based on the classifications assigned to building areas for potential contamination. Zones classified as C5 are potentially the most contaminated, such as the pretreatment cells. Zones classified as C1 are uncontaminated areas.

The confinement provided by physical barriers is enhanced by the ventilation system, which creates a pressure gradient and causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential. There will be no C4 areas in the pretreatment plant. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and, hence, the amount of air requiring treatment.

C1 Ventilation System (C1V)
C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation System (C2V)
C2 areas typically consist of nonprocess operating areas, access corridors, and control/ instrumentation, and electrical rooms. Filtered air will be supplied to these areas by the C2 supply system and will be cascaded into adjacent C3 areas or HEPA filtered and exhausted by the C2 Exhaust system.

C3 Ventilation System (C3V)
C3 areas normally will be unoccupied, but operator access during maintenance will be allowed. C3 areas typically will consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Access from a C2 area to a C3 area will be via a C2/C3 subchange room. Air will generally be drawn from C2 areas and cascaded through the C3 areas into C5 areas. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. In some areas, where higher flow may be required into C3 areas, a dedicated C2 supply will be provided with a backdraft damper on the C2 supply duct, which will be closed in the event of a loss of C3 extract. This system will shut down should there be a failure of the C5 exhaust system.

C5 Ventilation System (C5V)
The pretreatment plant C5 areas are designed with the cell or cave perimeter providing radiation shielding as well as a confinement zone for ventilation purposes. C5 areas typically consist of a series of process cells where waste will be stored and treated. The pretreatment plant hot cell will house major pumps and valves and other process equipment. Air will be cascaded into the C5 areas, generally from adjacent C3 areas, and extracted by the C5 extract system. The C5 exhaust system will be composed of Primary (PVP-HEPA-00001A/B/C) and Secondary (PVP-HEPA-00002A/B/C) HEPA Filters and variable speed Exhaust Fans (PJV-FAN-00001A/B/C). Fans designed to maintain continuous system operation will drive the airflow. This system will also be interlocked with the C3 HVAC system, to prevent backflow by shutting down the C3 system if the C5 HVAC system shuts down.

4.1.3 LAW Vitrification

The purpose of this section is to describe the major systems associated with the LAW vitrification plant. Figure 4A-3 presents a simplified process flow diagram of the LAW vitrification processes. This plant will consist of several process systems designed to perform the following functions:

- Receive and store pretreated LAW feed
- Convert blended LAW feed and glass formers into glass
- Provide melter offgas treatment systems
- Treat melter offgas
- Handle ILAW containers
- Store ILAW containers
- Provide supporting equipment in the melter gallery
- Handle miscellaneous waste
- Ventilate the LAW vitrification plant

The following figures located in Appendix 4A and drawings found in DWP Attachment 51, Appendix 9, provide additional detail for the LAW vitrification plant:

- Simplified flow diagrams for the WTP and the LAW vitrification plant
- Process flow figures and drawings for process information
- Typical system figures depicting common features for each regulated system
- General arrangement figures and drawings showing locations of regulated equipment
- Waste management area figures and drawings showing plant locations to be permitted

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment unit sub-systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.
- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of mixed or dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.
- Loss of mixing function: Tank systems are instrumented (air pressure/flow indication) to prevent hydrogen accumulation and solids settling. Tanks with agitators are instrumented to prevent agitator and/or vessel damage at low liquid level.
- Unsafe or off-normal melter operating conditions
- Degraded emissions control equipment and/or operating conditions
- Loss of air flow: The ventilation system are designed to creates a pressure gradient which causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential.
- Loss of site power

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment unit systems in some cases. Additional information may be found in the system logic descriptions located in DWP Attachment 51, Appendix 9.13. Regulated process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.F for tank systems and in DWP Table III.10.H.C for miscellaneous treatment unit sub-systems.

Descriptions of the LAW vitrification process, melter offgas treatment systems, and ILAW glass container handling systems are provided in the following sections.

The purpose of this section is to describe the major systems associated with the LAW vitrification plant. This plant will consist of several process systems designed to perform the following functions:

- Store pretreated LAW waste slurry
- Convert blended LAW waste slurry and glass formers into molten glass
- Provide melter offgas treatment systems
- Provide ILAW container handling systems
- Provide ILAW container finishing systems
- Provide storage areas for ILAW containers
- Provide supporting equipment for the melter
- Provide miscellaneous waste handling systems
- Provide LAW vitrification plant ventilation systems

Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-3 presents the simplified flow of primary process systems, and the following figures found in Appendix 4A provide additional detail for the LAW vitrification plant:

- Simplified process flow figures for process information
- Typical system figures depicting common features for each regulated system
- Simplified general arrangement figures showing locations of equipment and associated tanks
- Waste management area figures showing plant locations to be permitted
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant

Descriptions of the LAW vitrification process, melter offgas treatment systems, and ILAW glass container handling systems are provided in the following sections.

4.1.3.1 LAW Melter Feed Process

The LAW melter feed consists of the following systems:

- LAW concentrate receipt process system (LCP)
- LAW melter feed process system (LFP)
- Glass former reagent system (GFR) (the GFR system does not manage dangerous waste and is provided for information only)

Figure 4A-20 presents a simplified process flow diagram of the LAW Concentrate Receipt Process (LCP) System and the LAW Melter Feed Process (LFP) System. The LCP and LFP systems prepare feed for the LAW melters to produce a vitrified product. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste. There are two melter feed trains to supply the two LAW melters. Each melter feed train consists of a melter concentrate receipt vessel, a melter feed preparation vessel, and a melter feed vessel. The LCP system includes the melter concentrate receipt vessels. The LFP system includes the melter feed preparation vessel and the melter feed vessel for each of the two melters.

The LCP tank system consists of the following tanks and their associated ancillary equipment:

- Melter Concentrate Receipt Vessels (LCP-VSL-00001/2)

The LFP tank system consists of the following tanks and their associated ancillary equipment:

- Melter Feed Preparation Vessels (LFP-VSL-00001/3)
- Melter Feed Vessels (LFP-VSL-00002/4)

Melter Concentrate Receipt Vessels (LCP-VSL-00001/2)
The Melter Concentrate Receipt Vessels receive melter feed concentrate from the pretreatment plant. The Melter Feed Preparation Vessels are located in two process cells, and each process cell contains a Melter Concentrate Receipt Vessel, a Melter Feed Preparation Vessel, and a Melter Feed Vessel. The vessels are equipped with the following:

- Mechanical agitator
- Pumps to transfer LAW concentrate
- Instrumentation for liquid level
- Internal spray wash nozzles
- Overflow nozzle to C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)
- Spare nozzles

Valves are located in the valve bulge. Valving in each bulge allows the LAW concentrate to be routed to the Melter Feed Preparation Vessels (LFP-VSL-00001/3), or to the Plant Wash Vessel (RLD-VSL-00003) if the Melter Concentrate Receipt Vessels (LCP-VSL-00001/2) are being cleaned out or if the contents of the vessels cannot be satisfactorily processed. In addition, LAW concentrate can be pumped between the two Melter Concentrate Receipt Vessels (LCP-VSL-00001/2).

Glass Former Reagent (GFR) System
The GFR system contains the glass former feed hoppers that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from the glass former system.

The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers.

The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers and to confirm that the glass formers are transferred out of the feed hoppers to the Melter Feed Preparation Vessels.

The glass formers are gravity-fed with a rotary feeder into the Melter Feed Preparation Vessels, where the glass formers are mixed with the waste feed. This equipment is located in an isolated area that serves as a contamination barrier between the melter feed preparation vessels and the glass former supply. The rotary valve controls the rate of glass former addition into the melter feed preparation vessels.

Melter Feed Preparation Vessels
The Melter Feed Preparation Vessels mix LAW concentrate from the Melter Concentrate Receipt Vessels with glass formers and sucrose from the glass former feed hoppers. The vessels are equipped with the following:

- Mechanical agitator
- Pumps
- Instrumentation for liquid level measurement
- Internal spray wash nozzles
- Overflow nozzle to the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)
- Spare nozzles

The two pumps transfer waste using a valve bulge. Valves in the valve bulge allow melter feed to be routed to the associated Melter Feed Vessel (LFP-VSL-00002/4) or to the Plant Wash Vessel (RLD-VSL-00003). The vessel contents can be circulated through the pump and injected back into the vessel in the recirculation mode. In addition, melter feed can be pumped between the two Melter Feed Preparation Vessels (LFP-VSL-00002/4).

Melter Feed Vessels (LFP-VSL-00002/4)
The Melter Feed Vessels receive blended melter feed, consisting of LAW concentrate and glass formers, from the Melter Feed Preparation Vessels (LFP-VSL-00001/3). The vessels are equipped with the following:

- Mechanical agitator
- Air displacement supply (ADS) pumps to transfer feed to the corresponding LAW melter
- Feed vessel pump
- Instrumentation for liquid level measurement
- Miscellaneous solution addition line
- Internal spray wash nozzles
- Overflow nozzle to the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)
- Spare nozzles

The feed vessel pump transfers waste feed through a valve bulge. Valving in the bulge allows the waste feed to be pumped between all four vessels: the two Melter Feed Preparation Vessels (LFP-VSL-00001/3) and the two Melter Feed Vessels (LFP-VSL-00002/4). Waste feed can also be transferred from the Melter Feed Vessels to the Plant Wash Vessel (RLD-VSL-00003) for vessel cleanout. Normally, ADS pumps transfer the melter feed from the melter feed vessel to the melter.

~~The LAW melter feed consists of the following systems:~~

- ~~LAW concentrate receipt process system (LCP)~~
- ~~LAW melter feed process system (LFP)~~
- ~~Glass former reagent system (GFR)~~

~~The LCP and LFP prepare feed for the LAW melters to produce a vitrified product. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste. There are three melter feed trains to supply the three LAW melters. Each melter feed train consists of a melter concentrate receipt vessel, a melter feed preparation vessel, and a melter feed vessel. The LCP includes the melter concentrate receipt vessels. The LFP includes the melter feed preparation vessel and the melter feed vessel for each of the three melters.~~

~~The LAW melter feed consists of the following vessels:~~

- ~~Melter concentrate receipt vessels (V21001, V21002, V21003)~~
- ~~Melter feed preparation vessels (V21101, V21201, V21301)~~

- ~~Melter feed vessels (V21102, V21202, V21302)~~

~~Melter Concentrate Receipt Vessels~~

~~The melter concentrate receipt vessels receive melter feed concentrate from the pretreatment plant. The melter feed preparation vessels are located in three process cells, and each process cell contains a concentrate receipt vessel, a feed preparation vessel, and a melter feed vessel. Each vessel is equipped with the following:~~

- ~~Mechanical agitator~~
- ~~Two pumps to transfer LAW concentrate~~
- ~~Instrumentation for liquid level and density measurement~~
- ~~Liquid level instrument~~
- ~~Thermowell/temperature sensor for temperature measurement~~
- ~~Internal wash rings~~
- ~~Overflow to C3/C5 drain/sump collection vessel~~
- ~~Spare nozzles~~

~~Valves are located in the valve bulge. Valving in each bulge allows the LAW concentrate to be routed to the feed preparation vessels, or to the plant wash vessel if the concentrate receipt vessel is being cleaned out or if the contents of that vessel cannot be satisfactorily processed.~~

~~Glass Former Reagent System (GFR)~~

~~The GFR contains the glass former feed hoppers that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from the LAW transporters located at the glass formers room. Each feed hopper is equipped with a pneumatic blending head at the base of the hopper to re-blend the glass former feed.~~

~~The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers.~~

~~The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers and to confirm that the glass formers are transferred out of the feed hoppers to the melter feed preparation vessels.~~

~~After the blending cycle the glass formers are gravity-fed with a rotary feeder into the melter feed preparation vessels, where the blended glass formers are mixed with the waste. This equipment is located in an isolated area that serves as a contamination barrier~~

~~between the melter feed preparation vessels and the glass former supply. The rotary valve controls the rate of glass former addition into the melter feed preparation vessels.~~

~~Melter Feed Preparation Vessels~~
~~The melter feed preparation vessels mix LAW concentrate from the melter concentrate receipt vessels with glass formers and sucrose from the glass former feed hoppers. The vessels are equipped with the following:~~

- ~~Mechanical agitator~~
- ~~Two pumps~~
- ~~Instrumentation for liquid level and density measurement~~
- ~~Liquid level instrument~~
- ~~Thermowell/temperature sensor for temperature measurement~~
- ~~Internal wash rings~~
- ~~Overflow to the cell sump~~
- ~~Spare nozzles~~

~~The two pumps transfer waste via a valve bulge. Valves in the valve bulge allow melter feed to be routed to the associated melter feed vessel, or to the plant wash vessel. The vessel contents can be circulated through the pump and injected back into the tank in the recirculation mode.~~

~~Melter Feed Vessels~~
~~The melter feed vessels receive blended melter feed, consisting of LAW concentrate and glass formers, from the melter feed preparation vessels. The vessels are equipped with the following:~~

- ~~Mechanical agitator~~
- ~~Pumps to transfer feed to the corresponding LAW melter~~
- ~~Pump~~
- ~~Instrumentation for liquid level and density measurement~~
- ~~Liquid level instrument~~
- ~~Thermowell/temperature sensor for temperature measurement~~
- ~~Miscellaneous solution addition line~~
- ~~Internal wash rings~~
- ~~Overflow to the cell sump~~
- ~~Spare nozzles~~

The pump transfers waste through a valve bulge. Valving in the bulge allows the waste to be routed to the corresponding melter feed preparation vessel in the event of melter shutdowns, to the same melter feed vessel to re-circulate for sampling, or to the plant wash vessel for vessel clean-out. The normal transfer is from the pump to the melter.

The LAW concentrate receipt vessels, the LAW melter feed preparation vessels, and LAW melter feed vessels will have instrumentation and interlocks to indicate or prevent the following conditions:

- Vessel overflow
- Loss of vessel integrity
- Loss of agitator function
- Agitator not operated at low liquid level to prevent agitator and vessel damage
- High temperature, and/or Level

Controls developed to prevent or mitigate accident conditions are incorporated into the design. Operating conditions that have been identified that require interlocking with the melter feed involve individual components within the offgas system that could result in overpressurization of the melter. These operating conditions include:

- Submerged bed scrubber overflow pipe to condensate vessel blockage, resulting in submerged bed scrubber flooding.
- Wet electrostatic precipitator flooding resulting in offgas system blockage.
- Chilled water cooling coils in submerged bed scrubber leak, resulting in flooding of submerged bed scrubber and offgas blockage.
- Offgas fan failure.
- Loss of off-site power.

The glass former feed hoppers will include an interlock to prevent the transfer of blended glass formers to the LAW melter feed preparation vessel if the agitator is not operating.

4.1.3.2 LAW Melter Process System (LMP)

Figure 4A-21 presents a simplified process flow diagram of the LAW Melter Process (LMP)System. The purpose of the LMP system is to convert a blended slurry of liquid LAW feed and glass former additives into a durable ILAW product. The LAW melter system design is based on operating two joule-heated ceramic melters in a C3 environment. Key functions of LMP include containment, joule heated melting, melter feed, and glass discharge.

Miscellaneous Treatment Unit Sub-Systems

- LAW Melters (LMP-MLTR-00001/2)

The LAW Melters (Appendix 4A, Figure 4A-48) have a nameplate capacity of 15 metric tons of glass per melter per day. The LAW Melter has a single internal glass chamber with a rectangular surface area. The melter is powered by three sets of electrodes mounted on opposite walls of the glass pool. The glass is discharged through either of two discharge chambers located within one of the long axis walls of the melter. The lid of the melter is composed of a layer of refractory backed by a corrosion-resistant metal plate and support structure. The lid also supports the components that are submerged in the melt pool and suspended in the melter plenum. The melter is encased in an integral shielding and secondary containment enclosure.

The refractory is part of the melter containment and can be described as two separate sections. These sections are the refractory in contact with the molten glass pool and the refractory surrounding the gas space above the glass pool, which is referred to as the plenum. The glass pool refractory, used in conjunction with active cooling provided by a water jacket, will provide glass containment, thermal insulation, and electrical isolation. The plenum refractory is primarily designed to resist thermal breakdown, resist corrosion by offgases, and resist corrosion by splashed feed and glass.

The melter shell consists of the lid and base plate as well as the structure needed to support the lid and provides a gas barrier. The melter shell inner surface is designed to allow operation of the melter at a negative pressure. This inner surface will also minimize the release of melter gases and contaminants in the event of melter pressurization. A small air purge will be provided for the annular space between the cooling panels and the shell to reduce the deposition of materials. This purge will be driven by melter vacuum.

The LAW melter system has been designed to shield and contain the melter so that no additional shielding or contamination control will be required for normal operations. This has been accomplished by enclosing the melter assembly in a steel box. Shielding is provided by the entire enclosure. Access panels are provided through the external shielding. When removed, these panels will allow access to the jack-bolts, electrodes, electrode thermocouples, viewing cameras, and so forth.

The heat for the LAW melter startup is provided by temporarily installed radiant electric heaters mounted on the roof of the melter. These heaters melt glass formers sufficiently to make it ionically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time, the melter reaches its operating temperature and slurry feeding can start. As water evaporates, the feed forms a "cold cap" on the surface of the melt. As more slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it is discharged into a container.

The melter plenum is maintained at a controlled vacuum with offgas system fans and injection of air into the offgas line near the melter exhaust. This assures containment and avoids pressurization.

Joule Heating
The joule heating system contains the melter electrodes, melter electrode power supplies, melter glass pool thermocouples, and the melter electrode control system.

The electrode configuration for each LAW Melter will consist of three pairs of plate electrodes mounted parallel to each other on the long axis of the melter. The electrodes will have forced-air cooled electrode extensions. The extensions will penetrate the side of the melter below the glass level to minimize the effects of thermal expansion and to minimize the potential for corrosion by sulfate. Active cooling of the extensions and the use of a water-cooling jacket will prevent glass from migrating through the refractory package adjacent to the electrode extension penetrations. Power to the electrodes will be single-phase alternating current applied across opposing electrodes. The nominal glass melt pool temperature is approximately 1,150 °C. This is measured with thermocouples in thermowells submerged into the pool at various locations. The power to the electrodes is regulated to maintain the temperature within a selected range.

Melter Feed System
Feed will be introduced to the melter as a slurry through nozzles in the melter lid. Water and volatile constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. Waste feed components in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the molten glass. The feed rate determines the cold cap coverage on the glass melt pool. The feed rate can be controlled based on the average plenum temperature measured by plenum thermocouples mounted in the melter lid. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Air injectors will be used to mix and agitate the molten glass. When the melt level rises to a predetermined upper limit, an air lift mechanism is actuated and glass is discharged to a container.

Glass Discharge System
Melter glass pool level measurement will be used to indicate when to start and stop glass discharge. It also provides alarms for high or low glass pool levels. Each LAW Melter has two identical and independently operated glass discharge systems located adjacent to each other on one side of the melter. Each of these systems includes an airlift riser, a glass pour trough, a heated discharge chamber, and other components and instruments needed to control the discharge of glass. When the canister is required for filling, it is taken out of the buffer rack in the Canister Handling Cave and transferred into the Pour

Tunnel bogie. The bogie travels to a position under the pour spout. As the bogie moves into position under the pour spout, the pour spout glass catch tray is pushed back and signals that a canister is present. A proximity switch detects that the bogie is in position, the bogie is then locked into position, and the canister is filled with glass.

The glass discharge from the melter is initiated by injecting air or an inert gas at the bottom of the airlift riser. As the gas bubbles rise in the glass they will entrain glass in the riser, which is replaced by glass flowing in from the pool through the riser throat. The glass is lifted to the inlet of the trough, where the air bubbles disengage and the entrained glass flows into the trough. The glass then flows down the trough due to gravity and falls from the pour tip at the end of the trough into the container. The rate of glass discharge is controlled by adjusting the rate at which air is injected into the bottom of the riser.

Instrumentation, alarms, controls, and interlocks will be provided for the LMP to indicate or prevent the following conditions:

- Decrease or loss of melter plenum vacuum
- Glass temperature too high
- Electrode extension temperature too high
- Loss of melter cooling water
- Plugged feed nozzle
- Overfilling of glass container

~~The purpose of the LMP is to convert a blended slurry of liquid LAW feed and glass former additives into molten glass. The glass is discharged from the melter into metal containers where it cools to form the ILAW.~~

~~The LAW melter system design is based on operating three joule-heated ceramic melters, identified as the LMP in a C3 environment. Key subsystems include containment, joule heating, melter feed, and glass discharge.~~

~~LAW Melters~~
~~The LAW melters have a design capacity range of approximately 10-15 metric tons of glass per 24-hour day, per melter. The LAW melter has a single internal glass chamber with a rectangular surface area. The melter is powered by three sets of electrodes mounted on opposite walls of the glass pool. The glass is discharged through either of two discharge chambers located within one of the long axis walls of the melter. The lid of the melter is composed of a layer of refractory backed by a corrosion resistant metal plate and support structure. The lid also supports the components that are submerged in the melt pool and suspended in the melter plenum. The melter is encased in an integral shielding and secondary containment enclosure.~~

~~The refractory is part of the melter containment and can be described as two separate sections. These sections are the refractory in contact with the molten glass pool, and the refractory surrounding the gas space above the glass pool, which is commonly referred to as the plenum. The glass pool refractory, used in conjunction with active cooling provided by a water jacket, will provide glass containment, thermal insulation, and electrical isolation. The plenum refractory is primarily designed to resist thermal breakdown, resist corrosion by offgases, and resist corrosion by splashed feed and glass.~~

~~The melter shell consists of the lid and base plate as well as the structure needed to support the lid, and provides a gas barrier. The melter shell inner surface is designed to allow operation of the melter at a negative pressure with minimal air in-leakage. This inner surface will also minimize the release of melter gases and contaminants in the event of melter pressurization. A small air purge will be provided for the annular space between the cooling panels and the shell to reduce the deposition of materials. This purge will be driven by melter vacuum.~~

~~The LAW melter system has been designed to shield and contain the melter so that no additional shielding or contamination control will be required for normal operations. This has been accomplished by enclosing the melter assembly in a steel box. Shielding is provided by the entire enclosure. Access panels are provided through the external shielding. When removed, these panels will allow access to the jack-bolts, electrodes, electrode thermocouples, viewing cameras, and so forth.~~

~~The heat for the LAW melter startup is provided by temporarily installed radiant electric heaters mounted on the roof of the melter. These heaters melt glass formers sufficiently to make it ironically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time, the melter reaches its operating temperature and slurry feeding can start. As water evaporates, the feed forms a "cold cap" on the surface of the melt. As more slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a container.~~

~~The melter plenum is maintained at a vacuum with offgas system fans and controlled injection of air into the offgas line near the melter exhaust. This assures containment and avoids pressurization.~~

~~Joule Heating~~
~~The joule heating system contains the melter electrodes, melter electrode power supplies, melter glass pool thermocouples, and the melter electrode control system.~~

~~The electrode configuration for each LAW melter will consist of three pairs of plate electrodes mounted parallel to each other on the long axis of the melter. The electrodes~~

will have forced-air cooled electrode extensions. The extensions will penetrate the side of the melter below the glass level to minimize the effects of thermal expansion and to minimize the potential for sulfate corrosion. Active cooling of the extensions and the use of a water-cooling jacket will prevent glass from migrating through the refractory package adjacent to the electrode extension penetrations. Power to the electrodes will be single-phase alternating current applied across opposing electrodes. The nominal glass melt pool temperature range is 950 °C to 1,250 °C. This is measured with thermocouples in thermowells submerged into the pool at various locations. The power to the electrodes is regulated to maintain the temperature within a selected range.

Melter Feed System
Feed will be introduced to the melter as a slurry through nozzles in the melter lid. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt. Air injectors will be used to mix and agitate the molten glass. As the slurry is fed, molten glass is formed that accumulates in the glass tank. When the melt level rises to a predetermined upper limit, an air lift mechanism is actuated and glass is discharged to a container. The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, which can be controlled based on the average plenum temperature.

Glass Discharge System
Melter glass pool level measurement will be used to indicate when to start and stop glass discharge. It also provides alarms for high or low glass pool levels. Each LAW melter has two identical and independently operated glass discharge systems located adjacent to each other along side of the melter. Each of these systems includes an airlift riser, a glass pour trough, a heated discharge chamber, and other components or instruments needed to control the discharge of glass.

The glass discharge from the melter is initiated by injecting air or an inert gas at the bottom of the airlift riser. As the gas bubbles rise in the glass they will entrain glass in the riser, which is replaced by glass flowing in from the pool through the riser throat. The glass is lifted to the inlet of the trough, where the air bubbles disengage and the entrained glass flows into the trough. The glass then flows down the trough due to gravity and falls from the pour tip at the end of the trough into the container. The rate of glass discharge is controlled by adjusting the rate at which air is injected into the bottom of the riser.

Instrumentation, alarms, controls, and interlocks will be provided for the LMP to indicate or prevent the following conditions:

- ~~Decrease or loss of melter plenum vacuum~~
- ~~Plenum pressurization~~
- ~~Glass temperature too high~~
- ~~Electrode extension temperature too high~~
- ~~Loss of melter cooling water~~
- ~~Plugged feed nozzle~~
- ~~Over filling of glass container~~

4.1.3.3 LAW Melter Offgas System

The LAW Melter Offgas System consists of the following process systems:

- LAW Primary Offgas Process (LOP) System
- LAW Secondary Offgas/Vessel Vent Process (LVP) System

Figure 4A-22 presents a simplified process flow diagram of the LAW Primary Offgas Process (LOP) System. The LOP tank system consists of the following tanks and miscellaneous treatment unit sub-systems and their associated ancillary equipment:

Tank System

- LAW Melter SBS Condensate Vessels (LOP-VSL-00001/2)
- Pumps
- Eductor (LOP-EDUC-00001)

Miscellaneous Treatment Unit Sub-Systems

- Primary and Secondary Film Coolers (LOP-FCLR-00001/2/3/4), one set for each melter
- Melter 1 and Melter 2 Submerged Bed Scrubbers (SBS)(LOP-SCB-00001/2)
- Melter 1 and Melter 2 Wet Electrostatic Precipitators (WESP) (LOP-WESP-00001/2)

Figure 4A-23 presents a simplified process flow diagram of the LAW Secondary Offgas/Vessel Vent Process (LVP)System. The LVP tank system consists of the following tanks and miscellaneous treatment unit sub-systems and their associated ancillary equipment.

Tank System

- LAW Caustic Collection Tank (LVP-TK-00001)

Miscellaneous Treatment Unit Sub-Systems

- Caustic Scrubber (LVP-SCB-00001)
- Electric Heaters (LVP-HTR-00001A/1B/2)
- Selective Catalytic Oxidizer (LVP-SCO-00001)
- Selective Catalytic Reducer (LVP-SCR-00001)
- Heat Exchanger (LVP-HX-00001)
- Activated Carbon Adsorbers (LVP-ADBR-00001A/1B)
- HEPA Filters (LVP-HEPA-00001A/1B/2A/2B/3A)
- Melter Offgas Exhausters (LVP-EXHR-00001A/B/C)
- LAW stack

Melter offgas is generated from the vitrification of LAW feed in the two joule-heated ceramic melters. The rate of generation of gases in the melter is dynamic. The melters generate offgas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the offgas include:

- Nitrogen oxides from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- Particulates and aerosols
- Entrained feed material and glass
- Mercury

In addition, the LAW Melters generate small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. Carbon-14 and tritium are in the form of carbon dioxide and water, respectively.

The purpose of the LAW Melter offgas system is to cool and treat the melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the cell. The design of the melter offgas system must accommodate changes in offgas flow from individual melters without causing the melter to pressurize and without allowing variations in the flow from one melter to impact the other melter.

Separate systems are provided for the initial treatment of offgas from each melter. This is considered the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of seven times steam and three times noncondensables nominal flow from feed. The primary system consists of a Film Coolers (LOP-FCLR-00001/3), Submerged Bed Scrubbers (LOP-SCB-00001/2), and a Melter

Wet Electrostatic Precipitator (LOP-WESP-00001/2). This system cools the offgas and removes particulates.

There is a second offgas line from the Melter to the Submerged Bed Scrubbers (LOP-SCB-00001/2) consisting of a Standby Film Cooler (LOP-FCLR-00002/4) and a butterfly valve as the isolation device. The melter is operated under negative pressure. In the event that the primary offgas line plugs or the melter surges beyond design basis, the butterfly valve opens allowing offgas flow to the submerged bed scrubber through the second offgas line, thereby preventing melter pressurization. The line is designed to handle surges up to seven times condensable and three times noncondensable from feed without causing melter pressurization. In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve opens venting the offgas to the wet process cell. Offgas from the wet process cell is drawn through HEPA Filters to remove particulates before discharged to the atmosphere. Once the melter pressure returns to the desired set point, the valve closes.

The vessel ventilation system offgas consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents. The vessel ventilation system header joins the primary offgas system after the Wet Electrostatic Precipitators (LOP-WESP-00001/2), and the combined offgas is routed to the secondary offgas treatment system.

The secondary offgas system (from HEPA preheater to final discharge) is designed to handle maximum sustained flowrate from the two melters assuming both melters are operating. The system is also capable of operating effectively if only one melter is running. The secondary offgas system consists of HEPA Filters (LVP-HEPA-00001A/1B/2A/2B) with Electric Heater (LVP-HTR-00001A/1B/3A/3B), Exhauster Fans (LVP-EXHR-00001A/B/C), mercury Adsorbers (LVP-ADBR-00001/2), a Selective Catalytic Oxidizer (LVP-SCO-00001)/Selective CatalyticReducer (LVP-SCR-00001/2) which houses the heat recovery unit (plate Heat Exchanger) (LVP-HX-00001), Electric Heater (LVP-HTR-00002), the catalyst for volatile organic compound oxidation and the catalyst for nitrogen oxides reduction, and a Caustic Scrubber (LVP-SCB-00001). The following sections provide descriptions of major melter offgas treatment components.

~~The LAW melter offgas system consists of the following process systems:~~

- ~~LAW Primary Offgas Process (LOP) System~~
- ~~LAW Secondary Offgas/Vessel Vent Process (LVP) System~~

~~Melter offgas is generated from the vitrification of LAW feed in up to three joule-heated ceramic melters. The rate of generation of gases in the melter is dynamic. The melters generate offgas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the offgas include:~~

- Nitrogen oxides (NO_x) from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- Cesium and technetium as the radionuclides of significance
- Entrained feed material and glass

In addition, the LAW Melters generate small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. Carbon-14 and tritium are in the form of carbon dioxide and water, respectively.

The purpose of the LAW Melter offgas system is to cool and treat the melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the cell. The design of the melter offgas system must accommodate changes in offgas flow from individual melters without causing the melter to pressurize and without allowing variations in the flow from one melter to impact other melters.

Separate systems are provided for the initial decontamination of offgas from each melter. This is considered the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of ten times nominal flow from feed. The primary system consists of a Film Coolers, Submerged Bed Scrubbers, and a Melter Wet Electrostatic Precipitator. This system cools the offgas and removes particulates.

In addition to the equipment listed above, the LAW melter offgas system contains the following vessels:

- LAW caustic scrubber blowdown vessel (V22001)
- Melter submerged bed scrubber condensate vessels (V22101, V22201, V22301)

Additionally, an extra line from the melter to the Submerged Bed Scrubbers is provided in the unlikely case that the primary offgas line plugs. This extra line is composed of as Film Cooler and a butterfly valve as the isolation device. As soon as the melter vacuum decreases to a set point, the butterfly valve is actuated and offgas flow is allowed through the line to the submerged bed scrubber, thereby preventing melter pressurization. In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the offgas to the wet process cell.

After the Melter Wet Electrostatic Precipitators, the dedicated offgas lines join plus the vessel ventilation header and are routed to the secondary offgas treatment system. The offgas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.

The secondary offgas system (from HEPA preheater to final discharge) is designed to handle maximum sustained flowrate from the three melters assuming the three melters are operating. The system is also capable of operating effectively if only one melter is running. The secondary offgas system consists of HEPA Filters with Electric Heater, Exhauster Fans, A Selective Catalytic Oxidizer/Selective CatalyticReduction Unit which houses the heat recovery unit (plate Heat Exchanger), Electric preHeater, the catalyst for volatile organic compound oxidation and the catalyst for NO_x reduction, and a Caustic Scrubber. The following sections provide descriptions of major melter offgas treatment components.

4.1.3.3.1 LAW Primary Offgas Process (LOP) System

Figure 4A-22 presents a simplified process flow diagram of the LAW Primary Offgas Process (LOP) System. The purpose of the LOP tank system and miscellaneous treatment unit sub-systems is to cool the offgas and remove aerosols generated by the melter. The primary components consist of a film cooler, submerged bed scrubber, and a wet electrostatic precipitator.

Film Cooler (LOP-FCLR-00001/2/3/4)
The primary function of the Film Cooler miscellaneous treatment unit sub-system is to cool the offgas and entrained molten glass droplets below the glass sticking temperature to minimize glass deposition on the offgas piping walls. The offgas exits the melter and is mixed with steam or steam/air mixture in the offgas Film Cooler. The Film Cooler is a double-walled pipe designed to introduce air/steam axially along the walls of the offgas pipe through a series of holes or slots in the inner wall. Each melter has a primary and a secondary Film Cooler.

Submerged Bed Scrubber (LOP-SCB-00001/2)
Each LAW Melter has a dedicated Submerged Bed Scrubber miscellaneous treatment unit sub-system. After each Film Cooler (LOP-FCLR-00001/3), the offgas enters the Submerged Bed Scrubber column for further cooling and solids removal. The Submerged Bed Scrubber is a passive device designed for aqueous scrubbing of entrained particulates from melter offgas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the offgas to a desired discharge temperature through the use of coiling coils/jacket. The offgas leaves the Submerged Bed Scrubber in approximate thermal equilibrium with the scrubbing solution.

The Submerged Bed Scrubbers (LOP-SCB-00001/2) have two offgas inlets, one for the normal operations line and one for the standby line. Secondary Film Coolers (LOP-FCLR-00002/4) can be routed to either Submerged Bed Scrubber. The offgas enters the Submerged Bed Scrubber through the appropriate inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate creating a lower skirt to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the Submerged Bed Scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected offgas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through cooling coils/jacket.

To maintain a constant liquid level within the Submerged Bed Scrubbers (LOP-SCB-00001/2), it will be equipped with an overflow line that allows for the continuous discharge of offgas condensate and some scrubbed particulates to the Melter SBS Condensate Vessels (LOP-VSL-00001/2) located next to the Submerged Bed Scrubber. The Melter SBS Condensate Vessels are equipped with a cooling jacket. The rate of condensate discharge is determined by how much the offgas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the Melter SBS Condensate Vessels. To minimize the buildup of the solids in the bottom of the Submerged Bed Scrubber, condensate from the Melter SBS Condensate Vessels (LOP-VSL-00001/2) will be re-circulated back to the Submerged Bed Scrubber and injected through multiple lances to agitate and suspend solids on the submerged bed scrubber floor. The collected solids will then be pumped directly off the Submerged Bed Scrubber vessel floor to the Melter SBS Condensate Collection Vessel (RLD-VSL-00005). This purging and recycling process occurs simultaneously. Submerged Bed Scrubber condensate from the SBS Condensate Collection Vessels (LOP-VSL-00001/2) ultimately flows to the TLP system. Venting of the Melter SBS Condensate Vessels is via the Submerged Bed Scrubber into the main offgas discharge pipe.

The scrubbed offgas discharges through the top of the Submerged Bed Scrubbers (LOP-SCB-00001/2) and is routed to the Melter Wet Electrostatic Precipitators (one per melter) (LOP-WESP-00001/2) for further particulate removal.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the Submerged Bed Scrubber to indicate or prevent the following conditions:

- High scrubber liquid temperature
- Low scrubber liquid level
- High condensate vessel liquid level
- Loss of chilled water supply
- Extremely high-pressure differential across the unit

Melter Wet Electrostatic Precipitators (LOP-WESP-00001/2)
The Submerged Bed Scrubber (LOP-SCB-00001/2) discharge is routed to the Melter Wet Electrostatic Precipitator miscellaneous treatment unit sub-system for removal of aerosols down to and including submicron size. Each melter system has a dedicated Melter Wet Electrostatic Precipitator (LOP-WESP-00001/2). The offgas enters the unit and passes through a distribution plate. The evenly distributed saturated gas then flows up through tubes which act as positive the electrodes. Each of the tubes has a single negatively charged electrode, which runs down the center of the tube. A high voltage, direct current transformer supplies power to the electrodes. A strong electric field is generated along the electrodes giving a negative charge to the aerosols passing through the tubes. The negatively charged particles move towards the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. The final condensate is collected in the Melter Wet Electrostatic Precipitators' (LOP-WESP-00001/2) dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution are routed to the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004).

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the Melter Wet Electrostatic Precipitators to indicate or prevent the following conditions:

- Loss of electrical power to the unit
- High differential pressure across the unit
- Accumulation of liquid
- Loss of process water supply

Standby Offgas Line
The standby line consists of an offgas pipe from the melter to a Submerged Bed Scrubber (LOP-SCB-00001/2), a Secondary Film Cooler (LOP-FCLR-00002/4), and a butterfly valve as the isolation device. During a melter surge or potential offgas pipe becoming plugged, this valve will open rapidly, providing an alternative path for the melter offgas to flow to the Submerged Bed Scrubbers (LOP-SCB-00001/2). With this alternative routing, pressure control on the melter plenum can be maintained. This standby offgas pipe will extend to the bottom of the Submerged Bed Scrubber packed bed, identical to the main offgas line. It is the same size as the main offgas line, thus providing a doubling of flow cross-section for melter-generated gases.

The LAW Melters are also equipped with a maintenance bypass line allowing offgases from one melter to be routed to the other's Submerged Bed Scrubber for cooling. The gas will be processed through both a primary and secondary offgas treatment system in the same manner as the normal path. The purpose of this line is to provide melter ventilation during idling conditions in the unlikely event that a Submerged Bed Scrubber (LOP-SCB-00001/2) or Melter Wet Electrostatic Precipitator (LOP-WESP-00001/2) requires maintenance. Prior to initiating use of the maintenance bypass line, waste feed would be secured, and the melters placed into an idle condition. No waste feed would be fed to the melters when the maintenance bypass line is in use.

Idling emissions from the melter are mainly heated air at a lower gas volume than expected during slurry feeding. The gas will be processed through secondary offgas treatment system that includes HEPA filtration, thermal catalytic oxidation, and selective catalytic reduction.

4.1.3.3.2 LAW Secondary Offgas/Vessel Vent Process (LVP) System

Figure 4A-23 presents a simplified process flow diagram of the LAW Secondary Offgas/Vessel Vent Process (LVP) System. The offgas system prevents migration of waste contaminants into the process cells and potentially operating areas. It does this by maintaining the various LAW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight mixed waste particulate contamination.

The vessel ventilation air is combined with the melter offgas prior to entering the secondary offgas system HEPA filter electric preheaters. The combined air streams are treated together in the remaining sections of the secondary offgas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation offgas system and the melter offgas system.

The melter offgas stream that is treated through the primary offgas system is combined with the vessel ventilation offgas stream and treated through the LVP tanks and miscellaneous treatment sub-systems. The secondary offgas system removes the remaining particulate, mercury and miscellaneous acid gases, gaseous nitrogen oxide compounds, carbon monoxide, and volatile organic compounds.

Descriptions of the tanks and miscellaneous treatment sub-systems comprising the LVP are provided below:

HEPA Filters, Electric Preheaters, and Exhausters
The purpose of these HEPA Filters miscellaneous treatment unit sub-system (LVP-HEPA-00001A/1B/2A/2B/3A) is to provide a final protection against dispersion of particulate. This helps protect the downstream equipment from particulate contamination. The combined offgas stream is first passed through the LAW melter offgas HEPA Electric Heaters (LVP-HTR-00001A/1B/2). Preheating increases the gas temperature above its dew point to avoid condensation in the melter offgas HEPA Filters. The offgas then passes through radial flow HEPA Filters. The system is composed of two parallel trains of two filter banks each in series. The offgas passes through one train while the other remains available as an installed backup. Motive force for the ventilation is provided by the Melter Offgas Exhausters (LVP-EXHR-00001A/B/C).

Instrumentation, alarms, controls, and interlocks will be provided for the LVP system to indicate or prevent the following conditions:

- High or low differential pressure across a HEPA filter signaling to switch to the redundant unit
- Loss of electric heater element

Additional information to the instrumentation, alarms, controls, and interlocks for the LVP system addressed in section 4.1.3 are described in the *LAW Vitrification Offgas Bypass Analysis*, 24590-LAW-PER-PR-03-001.

Activated Carbon Adsorber (LVP-ADBR-0001/2)
The Activated Carbon Adsorbers (LVP-ADBR-00001/2) miscellaneous treatment sub-system removes volatile mercury, iodine, and acid gases from the offgas. The offgas flows through two internal activated carbon beds normally operated in series. When gaseous mercury is detected breaking through the leading activated carbon bed, indicating that the carbon is loaded, the offgas flow is manually changed to make the trailing bed the leading bed. Only one activated carbon bed is used while the loaded activated carbon is removed and replaced. The flow is then changed to make the fresh activated carbon bed the trailing bed.

The activated carbon is batch loaded into the adsorber by gravity. The loaded activated carbon is batch removed by gravity and transferred by conveyor for collection in containers. A water fire suppression system may be included as a precaution against activated carbon fires, if required.

Instrumentation, alarms, controls, and interlocks will be provided for the Activated Carbon Adsorbers (LVP-ADBR-00001/2) to indicate or prevent the following conditions:

- Mercury breakthrough in the leading carbon adsorber signaling to switch to the trailing carbon adsorber
- High inlet/outlet carbon monoxide concentration difference activates a water deluge fire suppression system. The offgas inlet isolation damper is automatically closed and offgas flow is automatically diverted to the other carbon bed or to the bypass

Selective Catalytic Oxidizer (LVP-SCO-00001) and Selective Catalytic Reducers (LVP-SCR-00001)

The offgas is passed through a catalytic oxidizer/reducer skid (LVP-SKID-00002) housing a heat recovery exchanger (LVP-HX-00001), an electric heater (LVP-HTR-00002), VOC catalyst (LVP-SCO-00001), and SCR catalyst (LVP-SCR-00001) miscellaneous treatment unit sub-systems to remove volatile organics compounds, carbon monoxide, nitrogen oxide compounds, and acid gases in the offgas stream.

The heat recovery exchange first raises the offgas temperature using the hot offgas from the catalyst beds. The electric heater is used to supplement the heat recovery exchange primarily during start-up and when operating with low NO_x concentrations. The heated offgas is passed through the VOC catalyst to oxidize VOCs and carbon monoxide to carbon dioxide and water vapor. The offgas is then injected with a mixture of ammonia vapor and C3 air from an ammonia/air dilution skid. Following ammonia injection, the offgas is passed through the SCR catalyst to reduce NO_x to nitrogen and water vapor. The reduction reaction is exothermic, significantly increasing the offgas temperature. The outgoing hot offgas is cooled down in the heat exchanger and concurrently serves as the heating media for the incoming offgas. The cooled offgas stream is then directed to the Caustic Scrubber for acid gas removal and final cooling.

Instrumentation, alarms, controls, and interlocks will be provided for the Selective Catalytic Oxidizer / Selective Catalytic Reducers to indicate or prevent the following conditions:

- High differential pressure across each catalyst bed
- Loss of ammonia gas supply to the nitrogen oxides selective catalytic reduction unit
- Failure of the electric heater
- Ammonia analyzer to indicate ammonia slip in the outlet.
- Low offgas temperature entering the unit
- High temperature differential across the unit
- High nitrogen oxide concentration in the unit outlet stream
- High volatile organic compound concentration in the unit outlet stream

Caustic Scrubber (LVP-SCB-00001)
The LAW Melters' offgas Caustic Scrubber miscellaneous treatment unit sub-system further treats the offgas by removing iodine and acid gases and providing final offgas cooling. The offgas stream enters the bottom of the scrubber and flows upward through a packed bed. Contaminants in the offgas stream are absorbed into the liquid stream through interaction of the gas, liquid, and packing media. To neutralize the collected acid gases, a sodium hydroxide solution is added periodically to the LAW Caustic Collection Tank (LVP-TK-00001). The clean offgas is then discharged through an internal mist eliminator to prevent droplet carryover. The scrubbing liquid flows downward through the packing bed and drains into the LAW Caustic Collection Tank (LVP-TK-00001). This tank is periodically purged to the pretreatment plant. After passing through the Caustic Scrubber (LVP-SCB-00001), the offgas is released to the environment via a flue in the plant stack.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.3, the following will be provided for the Caustic Scrubber to indicate or prevent the following conditions:

- Loss of recirculation pump
- Loss of caustic supply
- Loss of process water supply
- High differential pressure across the column
- Low scrubbing liquid level
- High scrubbing liquid level
- Loss of transfer pump
- Low pH
- High specific gravity (density)

4.1.3.4 Radioactive and Nonradioactive Liquid Waste Disposal (RLD and NLD) Systems

DWP Attachment 51, Appendix 9.1 contains a process flow diagram of the Radioactive and Nonradioactive Liquid Waste Disposal (RLD and NLD) System. The RLD receives LAW vitrification process effluents for storage and transfer.

The RLD tank system consists of three main vessels:

- Plant Wash Vessel (RLD-VSL-00003)
- C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)
- SBS Condensate Collection Vessel (RLD-VSL-00005)

The SBS Condensate Collection Vessel (RLD-VSL-00005) and the Plant Wash Vessel (RLD-VSL-00003) are located in the LAW effluent cell. The C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004) is located below grade to provide fire protection water collection and to collect effluents from the wet electrostatic precipitator, a gravity floor drain system, and a pumped sump system.

Sources of effluents into the RLD system are production and nonproduction-related activities. Production effluents are mixed waste liquids or slurries routinely or periodically generated by the waste treatment process. These effluents are routed directly or indirectly to the SBS Condensate Collection Vessel (RLD-VSL-00005). Liquid effluent from nonproduction activities, such as vessel, equipment and cell/cave washes, and sump discharges, are routed to one of the three vessels, depending on the nature of the effluent. Dangerous or mixed waste is routed to either the Plant Wash Vessel (RLD-VSL-00003) or the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004).

Liquid that is nondangerous/nonradioactive is routed to the C1/C2 Floor Drain/Sump Collection Tank in the NLD system.

The functional purpose of the RLD system is to receive effluents for interim storage and to transfer the effluent to the pretreatment plant. In addition, mixing and sampling of the effluent may be performed in this system as required.

Plant Wash Vessel (RLD-VSL-00003)
This vessel is designed to receive the total volume of either the largest vessel in the LAW vitrification plant or the largest volume from the vessel/equipment wash or drain in the LAW vitrification plant. The largest volume is from the SBS Condensate Collection Vessel (RLD-VSL-00005). Effluent sources for the Plant Wash Vessel (RLD-VSL-00003) are vessel washes and the overflow from the SBS Condensate Collection Vessel (RLD-VSL-00005). The vessel is fitted with level instrumentation. The vessel is vented into a common vessel ventilation header that drains into the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004). During normal operation, the effluent characterized in the Plant Wash Vessel (RLD-VSL-00003) is expected to be transferred to the pretreatment plant.

C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004)
This vessel is designed to contain the maximum amount of fire protection water and the volume equivalent to the largest C3/C5 floor area wash. The C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004) routinely collects liquid drained from the Melter Wet Electrostatic Precipitators (LOP-WESP-00001/2). The overflow from the Melter Concentrate Receipt Vessels (LCP-VSL-00001/2) is also routed to the C3/C5 Drains/Sump Collection Vessel.

The C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004) is fitted with level instrumentation. The C3/C5 Drains/Sump Collection Vessel is vented into a common vessel ventilation header. Condensate that forms in the header drains into the C3/C5 Drains/Sump Collection Vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit.

Routine process-related effluent from Wet Electrostatic Precipitator drains will be pumped from this vessel to the SBS Condensate Collection Vessel, as necessary. Effluent generated from other sources will be pumped to the Plant Wash Vessel (RLD-VSL-00003) until it reaches a predetermined level to maintain adequate capacity for fire protection water.

The C3/C5 Drains/Sump Collection Vessel is located in an enclosed C3/C5 cell area. The C3/C5 Drains/Sump Collection Vessel overflows to a sump in the same cell. During normal operation, the effluent characterized in the C3/C5 Drains/Sump Collection Vessel is expected to be transferred to the TLP system via the SBS Condensate Collection Vessel (RLD-VSL-00005).

SBS Condensate Collection Vessel (RLD-VSL-00005)
This vessel is designed to store SBS column purge effluent. The SBS Condensate Collection Vessel (RLD-VSL-00005) routinely receives effluent from the Submerged Bed Scrubber (LOP-SCB-00001/2) and the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004).

The SBS Condensate Collection Vessel is fitted with level instrumentation and is vented into a common vessel ventilation header that drains into the C3/C5 Drains/Sump Collection Vessel (RLD-VSL-00004). Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. The SBS Condensate Collection Vessel overflows to the Plant Wash Vessel (RLD-VSL-00003). During normal operation, the effluent characterized in the SBS Condensate Collection Vessel is expected to be transferred to the TLP system.

~~The RLD receives LAW vitrification process effluents for storage and transfer.~~

~~The RLD consists of three main vessels:~~

- ~~Plant wash vessel (V25001)~~
- ~~LAW C3/C5 effluent DSCollection Vessel (V25002)~~
- ~~Submerged bed scrubber condensate collection vessel (V25003)~~

~~The submerged bed scrubber Condensate Collection Vessel and the plant wash vessel are located in the LAW effluent cell. The LAW C3/C5 effluent DSCollection Vessel is located below grade to provide fire protection water collection and to collect effluents from a gravity floor drain system and a pumped sump system.~~

~~Sources of effluents into the RLD are production and non-production related activities. Production effluents are radioactive liquids or slurries routinely or periodically generated by the waste treatment process. These effluents are routed directly or indirectly to the submerged bed scrubber Condensate Collection Vessel. Liquid effluent from non-production activities, such as vessel, equipment and cell/cave washes, and sump discharges, are routed to one of three vessels, depending on the nature of the effluent. Dangerous or radioactive waste is routed to either the plant wash vessel or the LAW C3/C5 effluent DSCollection Vessel. Liquid that is not radioactive is routed to the C1/C2 Floor Drain/Sump Collection Tank in the NLD.~~

~~The functional purpose of the RLD is to receive effluents for interim storage, and transfer the effluent to pretreatment plant or BOF facilities as appropriate. In addition, mixing and sampling of the effluent may be performed in this system as required.~~

Plant Wash Vessel

This vessel is designed to handle the largest capacity of either the largest vessel in the LAW vitrification plant or the largest volume from the vessel/equipment wash or drain in the LAW vitrification plant. The largest volume is from the submerged bed scrubber Condensate Collection Vessel. Effluent sources for the plant wash vessel are vessel washes and the overflow from the submerged bed scrubber Condensate Collection Vessel. The vessel is fitted with level and temperature instrumentation. The vessel is vented into a common vessel ventilation header that drains into the LAW C3/C5 effluent DSCollection Vessel. During normal operation, the effluent characterized in the plant wash vessel is expected to be transferred to the PWD.

LAW C3/C5 Effluent Collection Vessel

This vessel and the bermed area around the vessel are designed for the probable maximum amount of fire protection water as well as hold the volume equivalent to the largest C3/C5 floor area wash. The LAW C3/C5 effluent DSCollection Vessel routinely collects liquid drained from the Melter Wet Electrostatic Precipitators. This vessel is designed for a two day hold-up of the wet electrostatic precipitators effluent with three melters operating under expected operating conditions. The overflow from the Melter Concentrate Receipt Vessels (V21001, V21002, V21003) is also routed to this vessel DSCV.

TheDSC Vessel is fitted with level, density, and temperature instrumentation. The vessel (LAW C3/C5 Effluent DS Collection Vessel) is vented into a common vessel ventilation header. Condensate that forms in the header drains into the LAW C3/C5 effluent D SCollection Vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. Routine process-related effluent from wet electrostatic precipitator drains will be pumped from this vessel to the submerged bed scrubber Condensate Collection Vessel, as necessary. Effluent generated from other sources will be pumped to the plant wash vessel until it reaches a predetermined level to maintain adequate capacity for fire protection water. The LAW C3/C5 effluent DSC Collection Vessel is located in an enclosed C3/C5 cell area. The LAW C3/C5 effluent DSC Collection Vessel overflows to a sump in the same cell. During normal operation, the effluent characterized in the LAW C3/C5 effluent DSCollection Vessel is expected to be transferred to the PWD via the submerged bed scrubber Condensate Collection Vessel.

Submerged Bed Scrubber Condensate Collection Vessel

This vessel is designed to store submerged bed scrubber column purge effluent. The submerged bed scrubber Condensate Collection Vessel routinely receives effluent from Submerged Bed Scrubber column vessels and the LAW C3/C5 effluent DSCollection Vessel. It can also receive transfers from the submerged bed scrubber condensate vessels.

The DSC Vessel is fitted with level and temperature instrumentation. The vessel is vented into a common vessel ventilation header that drains into the LAW C3/C5 effluent

DSCollection vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. The submerged bed scrubber Condensate Collection Vessel overflows to the plant wash vessel. During normal operation, the effluent characterized in the submerged bed scrubber condensate collection vessel is expected to be transferred to the PWD.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD to indicate or prevent the following conditions:

- Level indication: Level in the vessel is monitored for process condition and status. High-high liquid level will result in an interlock trip that will stop the incoming transfer (shuts off pump or shuts valves). High level alarm alerts operators to a high-fill condition and after a set period time may result in an interlock trip. Low level alarm alerts operator to low-fill condition. Low-low level will result in the stop of outgoing transfer.
- Temperature indication: Temperature in the vessel is monitored for process condition and status.

4.1.3.5 Radioactive Solid Waste Handling (RWH) System

The primary functions of this system will be to provide equipment for the change out of LAW process vessels and other miscellaneous mixed wastes. This system provides the equipment to move waste out of the building.

The vessels are designed for 40 years of service. However, in the event of a failure, the process vessel will be prepared for export by rinsing, disconnection of the process lines, and decontamination. The vessel will be lifted out of the process cell and covered to prevent a spread of contamination. The vessel will be placed in an approved package staged for vessel receipt. Once closed and secured, the package, containing the vessel, will be delivered to an appropriate TSD facility. A similar process in reverse will be used for the introduction and installation of new LAW process vessels.

It is anticipated that LAW Melters will require replacement at some point. When the end of a melter's operational life is reached, residual molten glass will be removed as immobilized product, as much as is practical. The LAW Melter will be allowed to cool and then will be disconnected. The steel box in which the melter is enclosed will be sealed, decontaminated if required, and transported to an appropriate TSD facility.

Disposal of miscellaneous mixed waste streams created during operation will be done by packaging at the point of generation. Localized collection points and disposal routes will be established at logical and optimal locations to accommodate maintenance and operations. Waste containers will be transferred to a staging area where packages will be weighed, labeled, and decontaminated for nonfixed contamination, if needed, prior to export. The packaged waste forms will then be stored at the WTP until final disposition.

The primary functions of this system will be to provide methods and packaging for the change-out of LAW melter process vessels and other miscellaneous mixed wastes.

In the event of a failure, the out-of-service melter process vessel will be prepared for export by rinsing, disconnection of the process lines, and decontamination. The vessel will be lifted out of the process cell and covered, to prevent a spread of contamination. The vessel will be placed in an approved overpack container staged for vessel receipt. Once closed and secured, the overpack, containing the vessel, will be delivered to the central waste storage area . A similar process in reverse will be used for the introduction and installation of new LAW melter process vessels.

Disposal of miscellaneous mixed waste streams created during operation will be accomplished by packaging at the point of generation. Localized collection points and disposal routes will be established at logical and optimal locations to accommodate maintenance and operations. Waste containers will be transferred to a staging areas where packages will be weighed, placarded, and decontaminated for non-fixed contamination, if needed, prior to export. The packaged waste forms will then be transferred to the central waste storage area.

4.1.3.6 ILAW Glass Container Handling

The ILAW glass container handling activities will consist of the following systems:

- LAW container receipt handling system (LRH)
- LAW container pour handling system (LPH)
- LAW container finishing handling system (LFH)
- LAW container export handling system (LEH)

The individual systems and their primary functions are described below:

LAW Container Receipt Handling (LRH) System
The LRH system takes delivery of new ILAW containers and provides a means to transfer these empty containers to the LPH transfer bogie (wheeled cart for container transfer).

Container Receipt
After removal of the shipping overwrap and initial receiving inspection, the containers are placed on a conveyor system and transferred into the plant as needed. New containers are then logged into the tracking system.

Container Import
Prior to the need for additional containers, a final inspection and transfer takes place in the container import bay. Each new container is moved to a container inspection stand.

This allows an operator to assess the upper head/lifting flange area, including the "fill" opening, and to observe the inside of the container with a light.

The rest of the container is inspected as required, then the container is placed on the import line 1 or 2 staging conveyer, and the tracking log is updated. If the container inspection fails, it is logged and tagged appropriately and set aside.

Each time a container is placed on the conveyor, an operator initiates a conveyor transfer. The transfer serves to index containers on the staging conveyor forward so there is always a container in the "pickup" position on the airlock conveyor.

Container import instrumentation, alarms, controls, and/or interlocks will be provided as follows:

- The hatches are interlocked with the hoist and bogies so the hatch cannot be opened unless a process crane is positioned above the hatch. Conversely, the process cranes cannot leave hatch positions unless the hatch is closed and locked.
- The hatches are interlocked with the bogies so that the hatches can not open unless a bogie is positioned below the hatch. The interlock prevents the bogie from leaving the hatch position unless the hatch is closed.

LAW Container Pour Handling (LPH) System
Each of the LAW melters has two glass discharges that operate independently. Each melter discharge chamber is aligned with a glass pour cave under the melter cell with associated features for filling a container with glass. Containers can be filled using one pour cave, using alternating caves, or both caves at the same time using alternating lifts. The LPH system handles and positions product containers for filling with LAW glass product. The major pieces of equipment include the container turntable, container elevator, transfer bogies, and monorail hoists.

Container Turntable, Container Elevator, Glass Pour Seal Head
A container turntable is provided in each pour cave for handling containers. The turntable accommodates three containers and rotates to position them at three stations: the container transfer station, the container fill station, and the container cooling station. At each container location in the turntable is a lower overpack section that locates the containers and provides support. Containers remain in the overpack during the elevating and glass filling cycle.

As containers are filled and cooled, the turntable rotates to the transfer station where container changeout occurs. Cooled, full product containers are removed from the turntable and replaced with empty containers. The turntable is rotated to position the empty container at the fill station. The container elevator raises the empty container and lower overpack up to the glass pour seal head for container filling.

The elevator is equipped with features to provide a weight of the product container being supported. Weight is used to verify that a container is present and that it is empty. The weight must be between established minimum and maximum values for glass pouring to occur. Additionally, the weight can be used to ensure that container filling is occurring and to provide the rate of glass pouring. The elevator weight is not intended to give an accurate weight of the container; it is merely used as an indication of container presence and condition.

The glass pour seal head is the interface between the melter discharge and the product container during glass pouring. The seal head consists of a metal bellows arrangement that is connected to the melter discharge with the other end of the bellows open for interface with product containers.

Container fill level is monitored by a thermal imaging camera. The camera provides a view of the diameter and the upper one-half of a container. The thermal imaging camera indicates container fill level for primary control of fill rate and pour shut off. In the event of primary level detection failure, a gamma detector activates a high-high level shutdown.

The container is filled using several pours. The pour process occurs more quickly than glass can be made in the melter, resulting in lag time between pours. Rapid pouring allows molten glass to flow out to all edges of the container. Following the final glass pour batch, the container remains in position to provide initial container cooling and containment of final glass discharges. The container is then lowered to the turntable. The turntable is again rotated, placing the recently filled container at the cooling/venting station. Container cooling continues while another container undergoes the fill cycle. Once cooled, the container is rotated to the transfer position for export and the process is repeated.

Container Transportation

Another function of the LPH system is to provide product container transportation between the container transfer bogie and the pour cave turntable. The system transfers empty product containers from the container transfer bogie to the melter turntable, and transfers full product containers from the turntable to the transfer bogie in a manner that supports the plant throughput goals.

Concrete walls separate the pour caves from the bogie transfer tunnel. These walls have doorways large enough to allow the hoist units loaded with new or filled product containers to pass through them. The doorways are fitted with steel shield doors.

Concrete walls also separate the monorail maintenance facility from the bogie transfer tunnel. These walls have openings sized to prevent an ILAW container from entering the maintenance area. These doorways are also fitted with steel shield doors that provide radiological shielding from sources in the transfer tunnel during hands-on maintenance activities in the monorail maintenance facility.

Pour cave transfer operations are conducted remotely with only a few exceptions. Maintenance and recovery operations in the bogie transfer tunnel, such as a jammed grapple, may require hands-on intervention. Monorail hoist maintenance operations conducted in the maintenance facility are completely hands-on. Monorail hoist recovery operations can become a hands-on/remote combination depending on the failure details.

The LPH system provides a buffer storage area for ILAW containers in the event downstream processing lines become backed up. Additionally, ILAW container rework is conducted in the buffer storage area. Anticipated activities include ILAW container transfers into the buffer storage area from the container transfer bogies, container transfers within the buffer storage area, container transfer from the buffer storage area to the transfer tunnel, and container rework. The buffer storage area is adjacent to a crane maintenance facility. The crane maintenance area is shielded from the buffer storage area to allow hands-on maintenance in the crane maintenance facility and transfer tunnel while containers are present in the buffer storage area.

The LPH transfer tunnel runs from the bogie maintenance area on the west end of the plant to the buffer storage area at the east end of the building. The buffer storage area import/export positions are located within the container transfer corridor. Concrete walls with passages for ILAW containers separate the north and south buffer storage areas and the container transfer corridor. The passages are equipped with manually operated steel shield doors to support maintenance or bogie recovery operations that might be required in this portion of the transfer tunnel. The LFH hoists operating in the lidding area above this section of the container transfer corridor transfer ILAW containers to and from the buffer storage area import/export position.

Buffer storage area container transfer operations are conducted with the use of a bridge crane. The crane rails begin in the crane maintenance facility adjacent to the north end of the buffer storage area and extend south. The runway provides crane coverage to the crane maintenance area, the ILAW container buffer storage area, the container transfer corridor, and the two container import/export positions. There are container storage positions in the north and south portions of the store, and one rework position also in the south portion of the store. The rework position is located in the southeast corner of the ILAW container buffer storage area/rework area. The rework position can be fitted with a powered turntable, a pair of master-slave manipulators. A shielded window is located in this area. Directly east of the rework position, on the cold side of the buffer storage area, is a rework area operating platform that provides operator access to the master-slave manipulators and shielded window.

A winch is provided to support maintenance operations on the buffer storage area bridge crane. A steel shield door and a concrete wall separate the crane maintenance facility from the buffer storage area, allowing maintenance operations to be conducted while the buffer storage area contains full ILAW containers.

LAW Container Finishing Handling (LFH) System

Figure 4A-24 presents a simplified process flow diagram of the LAW container finishing handling system (LFH). There are two LFH finishing lines. The functions of the LFH system are to verify the container fill level, determine if inert fill is required, complete closure of the ILAW container, decontaminate the exterior of the container, and verify surface contamination levels before exporting the container. The system also has the ability to sample the solidified glass, place the glass shards in a vial, and make these vials available for transfer to the laboratory.

The filled containers are raised from the transfer tunnel into one of two finishing lines and placed on a bogie. The bogie with the container travels to the shard sampling station. A sample of the glass may be taken with the glass shard sampler. Based on the measured level in the container, inert fill is added as needed. From there the bogie travels to the container lidding station where the lid is mechanically secured to the container. After mechanically sealing the lid to the container, the bogie travels to the decontamination area.

At the decontamination station, the container is decontaminated with carbon dioxide pellets. Debris produced during decontamination is collected with a HEPA filtered exhaust system. This gas stream is then routed to the plant vent system where it is passed through the plant's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported to the swabbing station where it is surveyed for loose surface contamination to verify it meets the contamination requirements. The swabbing machine uses a power manipulator to maneuver the swabs over the surface. The contaminated swabs are then monitored to determine gamma-beta levels for smearable contaminates. If contamination levels exceed C2 contamination criteria, the container can go through the carbon dioxide decontamination station. If the container meets C2 contamination criteria, the bogie moves into the monitoring/export station. As the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the contamination requirement, it is classified as an out-of-specification container. Otherwise, the dose rate is measured and is recorded with the container's records. Out-of-specification ILAW containers are routed back through the decontamination stations until the radiological contamination levels are within specification. The container is then exported for shipment to the disposal site.

Instrumentation, alarms, controls, and interlocks will be provided for the LRH system to indicate or prevent the following conditions:

- Opening of personnel access door when container is present in the line transfer station
- Opening of personnel access door when either line transfer trap doors are open

- Opening of both line transfer trap doors at the same time
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the line transfer station

Decontamination Station

A decontamination station is located within each of the finishing lines in the LAW vitrification plant. After the ILAW container has been sealed, it is transported to the decontamination station. Equipment items located in the decontamination station include the carbon dioxide decontamination manipulator, turntable, and exhaust system. Most other items are located outside of the decontamination station, including the carbon dioxide pelletizer, the transport air compressor, and the liquid carbon dioxide storage and delivery system, exhaust fans, and HEPA filters.

The containers are decontaminated using carbon dioxide pellets. The carbon dioxide decontamination manipulator is fitted with an exhaust recovery hood to recover the effluent from the decontamination operation. Debris produced during decontamination is collected with a HEPA filtered exhaust system. This gas stream is then routed to the plant vent system where it is passed through the plant's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported from the decontamination station to the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the decontamination station to indicate or prevent the following conditions:

- Opening of the decontamination or decontamination/swabbing containment door during decontamination
- Opening of the decontamination and decontamination/swabbing containment door at the same time

Swabbing and Swabbing-Monitoring Station

At the swabbing station, containers are surveyed for loose surface contamination to verify that they meet the contamination requirement. The swabbing machine maneuvers the swabs over the container surface. After a prescribed area is covered, the contaminated swabs are exported away from radioactive source for monitoring to determine gamma-beta levels for smearable contaminates. If contamination levels exceed C2 criteria, the container is transported back into the decontamination station for rework. If the container meets C2 criteria, the turntable bogie moves into the export station.

Once the container is transported into the monitoring/export station from the swabbing station, a gamma monitor measures the dose rate of the decontaminated container. If the container exceeds the specified dose requirement, it is classified as an out-of-specification container; otherwise, the dose rate is measured and is recorded within the container's records. The container is then exported out of the monitoring/export station for shipment to the disposal site.

Instrumentation, alarms, controls, and interlocks will be provided for the swab monitoring station to indicate or prevent the following conditions:

- Personnel access when a container is present in swab monitoring station
- Opening of decontamination/swabbing or swabbing/export containment door during swabbing
- Opening of personnel access door when container is present in the swabbing station
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the decontamination area
- Opening of personnel access door if high concentration of carbon dioxide is present within the decontamination area
- Rotation of posting turntable during swabbing
- Export of swab if radiation levels from swab are higher than design radiation classification in the operational area

LAW Container Export Handling (LEH) System
The purpose of the LEH system is to load ILAW containers onto a transportation vehicle for transfer to a Hanford Site TSD unit. This system is contained in a truck bay on the east end of the LAW vitrification plant.

Under normal operations the ILAW container will be received from the LFH system through a hatch. Radiological dose rate and contamination level are determined and verified to be within limits prior to entering the LEH system. An overhead crane lifts the ILAW container through the hatch and places it on the transportation vehicle.

Operations are remote and maintenance is "hands-on" in the LEH system. The overhead crane is provided with closed circuit television cameras for operation when radiological conditions do not permit personnel access during the ILAW container loading.

~~The ILAW glass container handling activities will consist of the following systems:~~

- ~~LAW container receipt handling (LRH) system~~
- ~~LAW container pour handling (LPH) system~~
- ~~LAW container finishing handling (LFH) system~~
- ~~LAW container export handling (LEH) system~~

~~The individual systems and their primary functions are described below:~~

LAW Container Receipt Handling (LRH) System
The LRH takes delivery of new ILAW containers and provides a means to transfer those containers to the LPH transfer bogie (wheeled cart for equipment and container transfer).

Container Receipt
After removal of the shipping overwrap and initial receiving inspection, the containers are placed on a conveyor system and transferred into the facility as needed. New containers are then logged into the tracking system.

Container Import
Prior to the need for additional containers, a final inspection and transfer takes place in the container import bay. Each new container is moved to a container inspection stand. This allows an operator to assess the upper head/lifting flange area, including the "fill" opening, and to observe the inside of the container with a light.

The rest of the container is inspected as required, then the container is placed on the import line 1 or 2 staging conveyer, and the tracking log is updated. If the container inspection fails, it is logged/tagged appropriately and set aside until it can be surveyed out of the area.

Each time a container is placed on the conveyor, an operator initiates a conveyor transfer. The transfer serves to index containers on the staging conveyor forward so there is always a container in the "pickup" position on the airlock conveyor.

Container import instrumentation, alarms, controls, and/or interlocks will be provided as follows:

- The three trap doors are interlocked with the storage cranes and bogies so that the trap doors cannot be opened unless a process crane is positioned above the trap door. Conversely, the process cranes cannot leave trap door positions unless the trap door is closed and locked.
- The trap doors are also interlocked with the bogies so that the doors can not open unless a bogie is positioned below the trap door. The interlock prevents the bogie from leaving the trap door position unless the trap door is closed.
- The storage cranes are interlocked with the hoists so that the cranes can only move with the grapple at transport height.
- The storage cranes are interlocked so that their hoists can only be lowered when signal confirms door is in open position.
- The storage cranes are interlocked to prevent them from colliding.

LAW Container Pour Handling (LPH) System

Each of the three LAW melters has two glass discharges that operate independently. Each melter discharge is provided with a glass pour cell under the melter cell and associated features for filling a container with glass. The melter will alternate filling containers in each pour cell. After a container is filled in one pour cell the melter will begin filling the next container in the other pour cell, although containers can be filled in the same pour cell. Each pour cell is physically isolated from the others for maintenance access. The LPH handles and positions product containers for filling with LAW glass product. The major pieces of equipment include the container turntable, container elevator, transfer bogies, and monorail hoists.

Container Turntable, Container Elevator, Glass Pour Seal Head

A container turntable is provided in each pour cell for handling containers. The turntable accommodates three containers and rotates to position them at three stations: the container import/export station, the container fill station, and the container cooling station. At each container location in the turntable is a lower overpack section that locates the containers and provides support. Containers remain in the overpack during the elevating and glass filling cycle.

As containers are filled and cooled, the turntable rotates to the import/export station where container changeout occurs. Cooled, full product containers are removed from the turntable and replaced with empty containers. Once the empty container's lid has been removed, the turntable is rotated to position the empty container at the fill station. The container elevator raises the empty container and lower overpack up to the glass pour seal head for container filling. At the upper position a lock bolt is engaged to ensure elevator position during the container fill cycles.

The elevator is equipped with features to provide a weight of the product container being supported. Weight is used to verify that a container is present and that it is not full of glass. The weight must be between established minimum and maximum values for glass pouring to occur. Additionally, the weight can be used to ensure that container filling is occurring and to provide the rate of glass pouring. The elevator weight is not intended to give an accurate weight of the container; it is merely used as an indication of container presence and condition.

The glass pour seal head is the interface between the melter discharge and the product container during glass pouring. The seal head consists of a metal bellows arrangement that is connected to the melter discharge, with the other end of the bellows open for connection to product containers.

Container fill level is monitored by a thermal imaging camera. The camera provides a complete view of the diameter of and the upper two-thirds of a container. The thermal imaging camera indicates canister fill level for primary control of fill rate and pour shut off. In the event of primary level detection failure, a gamma detector activates a high-high level shutdown.

The container is filled using several pours. The pour process occurs more quickly than glass can be made in the melter, resulting in lag time between pours. Rapid pouring allows molten glass to flow out to all edges of the container. Following the final glass pour batch, the container remains in position to provide initial container cooling and containment of final glass discharges. The elevator lock is then retracted and the container lowered to the turntable. The turntable is again rotated, placing the recently filled container at the cooling/venting station. Container cooling continues while another container undergoes the fill cycle. Once cooled, the container is rotated back to the import/export station and the process is repeated.

Container Transportation

The function of the LPH is to provide product container transportation between the container transfer bogie and the melter turntable. The system transfers empty product containers from the container transfer bogie to the melter turntable, and transfers full product containers from the turntable to the transfer bogie in a manner that supports the plant throughput goals.

Concrete walls separate the pour caves from the bogie transfer tunnel. These walls have doorways large enough to allow the hoist units loaded with new or filled product containers to pass through them. The doorways are fitted with steel shield doors.

Concrete walls also separate the monorail maintenance facility from the bogie transfer tunnel. These walls have passages large enough to allow the hoist units, loaded with spare parts, to pass through them. These doorways are also fitted with steel shield doors that provide radiological shielding from sources in the drum transfer tunnel during hands-on maintenance activities in the monorail maintenance facility.

Pour cave transfer operations are conducted remotely, with only a few exceptions. Maintenance/recovery operations in the bogie transfer tunnel, such as a jammed grapple, may require hands-on intervention. Monorail hoist maintenance operations conducted in the maintenance facility are completely hands-on. Monorail hoist recovery operations can become a hands-on/remote combination depending on the failure details.

The LPH provides a buffer storage area for ILAW containers in the event down stream processing lines become backed up. Additionally, ILAW container rework that cannot be managed locally is conducted in the buffer storage area. Anticipated activities include ILAW container transfers into the buffer storage area from the container transfer bogies, container transfers within the buffer storage area, container transfer from the buffer storage area to the transfer tunnel, and container rework. The buffer storage area is adjacent to a crane maintenance facility. The buffer storage area is shielded to allow

~~hands-on maintenance in the crane maintenance facility and drum transfer tunnel while containers are present in the buffer storage area.~~

~~The LPH drum transfer tunnel runs all the way to the east end of the building. The buffer storage area import/export positions are located within the container transfer corridor. Concrete walls with passages for ILAW containers separate the north and south buffer storage areas and the container transfer corridor. The passages are equipped with manually operated steel shield doors to support maintenance or bogie recovery operations that might be required in this portion of the transfer tunnel. The LFH hoists operating in the lidding area above this section of the container transfer corridor transfer ILAW containers to and from the buffer storage area import/export position.~~

~~Buffer storage area container transfer operations are conducted with the use of a 10-ton bridge crane. The crane runways begin in the crane maintenance facility adjacent to the north end of the buffer storage area and extends south. The runways provide crane coverage to the crane maintenance area, the ILAW container buffer storage area, the container transfer corridor and the two container import/export positions. There are container storage positions in the north portion of the store, a minimum of five container storage positions in the south portion of the store, and one rework position, also in the south portion of the store. The rework position is located in the southeast corner of the ILAW container buffer storage area/rework area. The rework position can be fitted with a powered turntable, a pair of master-slave manipulators, and a shielded window. Directly east of the rework position, on the cold side of the buffer storage area, is a rework area operating platform that provides operator access to the master-slave manipulators and shielded window.~~

~~A crane suspended from the maintenance facility ceiling is used to support maintenance operations on the buffer storage area bridge crane. A steel shield door, along with a concrete wall rising from the floor separate the crane maintenance facility from the buffer storage area. They allow maintenance operations to be conducted while the buffer storage area contains full ILAW containers.~~

~~LAW Container Finishing Handling (LFH) System~~
~~The functions of the LFH are to verify the glass volume, determine if inert fill is required, complete closure of the ILAW container, decontaminate the exterior of the container, and to verify contamination levels before exporting the container into the container storage area. The system also has the ability to sample the solidified glass, places the glass shards in a vial, and passes these vials to the laboratory.~~

~~The filled containers are raised from the transfer tunnel into one of two finishing lines and placed on a bogie. The bogie with the container travels to the shard sampling station. A sample of the glass is taken with the glass shard sampler. Based on the calculated volume in the container, inert fill is added as needed. From there the bogie travels to the~~

container weld station. Upon completion of container welding, the bogie travels to the decontamination area.

There are two separate decontamination areas that perform the same function. The container is then electrically grounded and decontaminated with CO_2 pellets. Produced Debris is collected with a HEPA-filtered exhaust system. This gas stream is then routed to the facility vent system where it is passed through the facility's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported to the swabbing station where it is surveyed for loose surface contamination to verify it meets the contamination requirements. The swabbing machine uses a power manipulator to maneuver the cotton swabs over the surface. The contaminated swabs are then monitored to determine gamma-beta and alpha levels for smearable contaminates. If contamination levels exceed C2 contamination criteria, the container can go through the CO_2 decontamination station or be transported into the fixative station where fixative is sprayed over the entire surface of the container and after curing the container is resurveyed. If the container meets C2 contamination criteria, the bogie moves into the monitoring/export station. As the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the contamination requirement, it is classified as an out-of-specification container. Otherwise, the dose rate is measured and is recorded with the container's records. Out-of-specification ILAW containers are routed back through the decontamination and fixative stations until the radiological contamination levels are within specification. The container is then exported to the product container storage and export.

Instrumentation, alarms, controls, and interlocks will be provided for the LRH to indicate or prevent the following conditions:

- Opening of personnel access door when container is present in the line transfer station
- Opening of personnel access door when either line transfer trap doors are open
- Opening of both line transfer trap doors at the same time
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the line transfer station

Decontamination Station
The two decontamination stations are located within the finishing line in the LAW vitrification plant. After the ILAW container has been cooled and sealed, it is transported to the CO_2 blasting decontamination station. The container is electrically grounded during blasting operation due to static electricity generated during CO_2 blasting. Equipment items located in the decontamination station include the CO_2 gun, exhaust system, and tracking system. Most other items are located outside of the hot cell,

including the CO_2 pelletizer, the transport air compressor, and the liquid CO_2 storage and delivery system.

The containers are decontaminated with CO_2 pellets. The CO_2 blasting gun contains a exhaust recovery hood to recover the effluent from the cleaning operation. Debris produced during decontamination is collected with a HEPA-filtered exhaust system. This gas stream is then routed to the facility vent system where it is passed through the facility's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported from the decontamination station to the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the decontamination station to indicate or prevent the following conditions:

- Opening of welding/decontamination or decontamination/swabbing containment door during decontamination
- Opening of welding/decontamination and decontamination/swabbing containment door at the same time

Swab and Swab-Monitoring Station

At the swabbing station, containers are surveyed for loose surface contamination to verify that they meet the contamination requirement. The swabbing machine uses a manipulator to maneuver the swabs over the surface. After a prescribed area is covered, the contaminated swabs are exported away from radioactive source for monitoring to determine gamma-beta and alpha levels for smearable contaminates. If contamination levels exceed C2 criteria, the container is transported back into the decontamination station for rework. If contamination levels are still above C2 criteria, the container is transported into the fixative station, located above the swabbing station. If the container meets C2 criteria, the turntable bogie moves into the monitoring/export station.

Once the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the specified dose requirement, it is classified as an out-of-specification container; otherwise, the dose rate is measured and is recorded within the container's records. The container is then exported out of the decontamination area into product container storage and export.

Instrumentation, alarms, controls, and interlocks will be provided for the swab monitoring station to indicate or prevent the following conditions:

- Personnel access when a container is present in swab monitoring station

- Opening of decontamination/swabbing or swabbing/export containment door during swabbing
- Opening of personnel access door when container is present in the swabbing station
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the decontamination area
- Opening of personnel access door if high concentration of carbon dioxide is present within the decontamination area
- Rotation of posting turntable during swabbing
- Export of swab if radiation levels from swab are higher than design radiation classification in the operational area
-

Container Fixative Station

After CO_2 decontamination, if contamination levels are still above C2 criteria, the container may be transported into the fixative station, through the fixative hatch using the fixative crane. The container is placed onto the cooling/drying stand where The container is allowed to cool to the desired temperature. The fixative crane transports the container into the fixative booth and the fixative nozzle sprays a fixative over the entire container surface. After curing, the container is lowered back into the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the fixative unit to indicate or prevent the following conditions:

- Opening of the fixative booth containment door during the fixative process.
- Start of system when the fixative booth containment door is open.
- Start of system when personnel are present within the fixative booth.
- Start of system if ventilation system fails. If ventilation fails during the fixative process, fixative system automatically shuts down.

Container Monitoring/Export Station

Before final export to the storage area, each container received from the swabbing station is measured for surface dose rate levels. A gamma scan array is used to measure dose rate from the container. The operator will verify the process, then record the reading. If the container fails to meet the surface dose rate requirements, the container is labeled as an out-of-specification container. The container is finally exported to the product container storage and export area.

Container monitoring/export station instrumentation, alarms, controls, and/or interlocks will be provided to indicate and/or prevent the following conditions:

- Opening of the personnel access door when storage trap door is open
- Opening of the storage trap door when personnel are present within the export station

LAW Container Export Handling (LEH) System

The purpose of the LEH is to store ILAW containers prior to transferring to a Hanford Site TSD unit. This system is composed of a storage facility, export/swabbing area, truck bay, and two separate crane maintenance areas. The ILAW containers are stored in the large structure. Loading of containers onto transportation trucks occurs in the export high bay area. Containers are swabbed and loaded into transportation flasks.

Under normal operation, an ILAW container will be received from the LFH, through a trap door. The ILAW container contamination and radiation dose limits are verified to be within specifications. An operator records the container's identification and position as it is placed into the storage array.

The impact of temperature, shielding, and environmental conditions were considered in the design of the storage plant and equipment within the plant, in terms of corrosion, degradation, and accessibility to equipment. The crane area is provided with closed circuit TV cameras for in-plant surveillance. A lighting system with fixtures provides the required illumination. Since personnel are excluded from entry due to radiological dose rates, remote access to each container is provided overhead.

4.1.3.7 LAW Melter Equipment Support Handling (LSH) System

The primary function of the LSH system is to provide the equipment and support necessary to complete maintenance tasks on all melters and equipment in the melter gallery of the LAW vitrification plant. The primary equipment used in support of the maintenance efforts are:

- Consumable change-out boxes
- Consumable change-out boxes storage racks
- Consumable change-out boxes preparation stand
- Melter gallery process cranes
- Consumable change-out boxes handler
- Lifting head
- Melter gamma gate
- Shield cover removal tool

Melter consumables will be removed through the top of the melter shielding. Melter consumable items will be those that require routine and nonroutine maintenance, but provide necessary functions to continue melter operations. The routine consumable items will be bubbler assemblies. New bubbler assemblies will be shipped to the plant and will be installed into the melter. Spent bubblers will be extracted from the melter and packaged into a box for disposal.

Refractory thermocouples, airlifts, level detectors, feed nozzles, and film coolers will be considered nonroutine and are replaced on an as-needed basis according to the appropriate procedures and with appropriate equipment.

~~The primary function of the LSH is to provide the equipment and support necessary to complete maintenance tasks on all melters and equipment in the melter gallery of the LAW vitrification plant. The primary equipment used in support of the maintenance efforts are:~~

- ~~Consumable change-out boxes~~
- ~~Consumable change-out boxes storage racks~~
- ~~Consumable change-out boxes preparation stand~~
- ~~Melter gallery process crane~~
- ~~Consumable change-out boxes handler~~
- ~~Lifting head~~
- ~~Melter gamma gate~~
- ~~Shield cover removal tool~~

~~Melter consumables will be removed through the top of the melter shielding. Melter consumable items will be those that require routine and non-routine maintenance, but provide necessary functions to continue melter operations. The routine consumable items will be bubbler assemblies. New bubbler assemblies will be shipped to the facility and will be installed into the melter. Spent bubblers will be extracted from the melter, cut up, and packaged into a drum for disposal.~~

~~Refractory thermocouples, airlifts, level detectors, feed nozzles, and film coolers will be considered non-routine and are replaced on an as-needed basis according to the appropriate procedures and with appropriate equipment.~~

~~The LSH also provides the methods, equipment, and packaging for the import of new melter bubbler assemblies and export of spent melter bubbler assemblies as well as removal of melter consumables.~~

4.1.3.8 LAW Vitrification Plant Ventilation

The LAW vitrification plant will be divided into four numbered zones (the C4 designation is not used) listed and defined below, with the higher number indicating greater radiological hazard potential and therefore a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this concept in the design and operation of the LAW vitrification plant will ensure that the ventilation air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An ~~effluent~~ exhaust air radiation monitoring system, consisting of sensors to monitor radiation in the ~~effluent~~ exhaust air stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor, and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation (C1V) System

C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation (C2V) System

C2 areas will typically consist of nonprocess operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated air handling units and exhaust fans. Ventilation air supplied to C2 areas will be exhausted by the C2 exhaust system and cascaded into adjacent C3 areas. The sum of the volumetric flow rates exhausted by the C2 exhaust system and cascaded into adjacent C3 areas will be greater than the volumetric flow rate supplied to C2 areas. This will cause the C2 areas to maintain a nominal negative pressure relative to atmosphere. C2 exhaust will pass through one stage of HEPA filters and be discharged to the atmosphere by the exhaust fans. Supply and exhaust fans are provided with variable frequency drives.

C3 Ventilation (C3V) System

C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. ~~When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used.~~ C3 exhaust will pass through one stage of HEPA ~~F~~filters and be discharged to the atmosphere by the exhaust fans. C3 exhaust fans are provided with variable frequency drives.

C5 Ventilation (C5V) System
~~In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed.~~ Where there is in-bleed air from the C3 system to the C5 system, fan cascade trip interlocks protect the system from backflow.

The C5 areas in the LAW vitrification plant will be composed of the following:

- Pour caves
- ~~Drum~~ Container transfer tunnel
- Buffer storage area
- C3/C5 drains/sump collection vessel ~~tank~~ room
- Process cells
- Finishing line

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered ~~duct~~ ventilation pipe entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow ~~HEPA filter~~ isolation dampers. C5 exhaust will pass through two stages of HEPA filters and be discharged to the atmosphere by the exhaust fans. C5 exhaust fans are provided with variable frequency drives.

4.1.3.9 LAW Melter Handling (LMH) System

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4.1.4 HLW Vitrification Plant

Figure 4A-4 presents a simplified process flow diagram of the HLW vitrification processes. The HLW vitrification plant will consist of several process systems designed to perform the following functions:

- Receive pretreated HLW slurry
- Convert blended HLW slurry and glass formers into glass
- Treat melter offgas
- Handle IHLW ~~containers~~ canisters
- Store IHLW ~~containers~~ canisters
- Provide supporting equipment in the melter cave
- Handle miscellaneous secondary waste

- Ventilate the HLW vitrification plant

The following figures located in Appendix 4A and drawings found in DWP Attachment 51, Appendix 10 provide additional detail for the HLW vitrification plant:

- Simplified flow diagram for the WTP
- Process flow figures and drawings for process information
- Typical system figures depicting common features for each regulated system
- General arrangement figures and drawings showing locations of regulated equipment
- Waste management area figures and drawings showing plant locations to be permitted

Instrumentation, alarms, controls, and interlocks will be provided for the tank systems and miscellaneous treatment systems to indicate or prevent the following conditions, as appropriate:

- Overfilling: Plant items are protected against overfilling by liquid level indication, high level instrumentation interlocks to shut off feed sources, and process control system control functions backed up by hard wired trips as required.

- Loss of containment: Plant items are protected against containment loss by liquid level indication, and by process control system control and alarm functions as required, including shut off of feed sources. Each plant item that manages liquid mixed or dangerous waste is provided with secondary containment. Sumps associated with the management of mixed or dangerous waste are provided with liquid level instrumentation and an ejector or pump to empty the sump as needed.

- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or to the wrong location.

- Loss of mixing function: Tank systems are instrumented (air pressure/flow indication) to prevent hydrogen accumulation and solids settling. Tanks with agitators are instrumented to prevent agitator and/or vessel damage at low liquid level.

- Unsafe or off-normal melter operating conditions

- Degraded emissions control equipment and/or operating conditions

- Loss of air flow: The ventilation system is designed to create a pressure gradient which causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential.
- Loss of site power

In addition to level control, temperature and pressure may be monitored for tank systems and miscellaneous treatment systems in some cases. Regulated process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.G for tank systems and in DWP Table III.10.J.C for miscellaneous treatment sub-systems.

Descriptions of the HLW vitrification process, melter offgas treatment systems, and IHLW glass canister handling systems are provided in the following sections.

~~Figure 4A-1 presents the simplified flow diagram for the WTP, Figure 4A-4 presents the simplified flow of primary process systems, and the following figures found in Appendix 4A provide additional detail for the HLW vitrification plant:~~

- ~~Simplified process flow figures for process information~~
- ~~Typical system figures depicting common features for each regulated system~~
- ~~Simplified general arrangement figures showing locations of equipment and associated tanks~~
- ~~Waste management area figures showing plant locations to be permitted~~

~~Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant~~

~~Descriptions of the HLW vitrification process, melter offgas treatment systems, and IHLW glass container handling systems are provided in the following sections.~~

4.1.4.1 HLW Melter Feed Process

The following HLW melter feed description is identical for both Melter 1 (HMP-MLTR-00001) and Melter 2 (HMP-MLTR-00002). The HLW melter feed process consists of the following:

- HLW concentrate receipt process (HCP) system
- HLW melter feed process (HFP) system
- HLW glass formers reagent (GFR) system (the GFR system does not manage dangerous waste and is provided for information only)

The primary function of this tank system is to receive HLW feed slurry from the pretreatment plant, mix glass formers with HLW feed to form a uniform blend, and provide a blended feed to the HLW melter. An analysis of the waste determines a glass

additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste.
The HCP system consists of the transfer piping from PTF to HLW and one sump and ancillary equipment.

The HFP system consists of the following vessels and associated ancillary equipment:

- Feed Preparation Vessel (HFP-VSL-00001/5)
- HLW Melter Feed Vessel (HFP-VSL-00002/6)

The HFP system receives waste from the HLW Feed Blend Vessel (HLP-VSL-00028) or its backup HLW Lag Storage Vessel (HLP-VSL-00027B) located in the Pretreatment Plant. Waste is transferred from the HLP system, through underground waste transfer piping between the PTF and HLW plants, to either of the Feed Preparation Vessels (HFP-VSL-00001/5) for blending with glass formers from the glass former feed hopper. Process control samples are collected from these vessels and analyzed to determine the glass former formulation. After completion of sample analysis, a batch of The glass former feed hopper receives blended glass formers and reductant (such as silica, boric acid, calcium silicate, ferric oxide, lithium carbonate, and sucrose) from the balance of facilities glass former system. After the blending, the glass formers are gravity-fed into the feed preparation vessel, where the blended glass formers are mixed with the HLW concentrate to form a uniform slurry. The slurry is then fed to either of the HLW Melter Feed Vessels (HFP-VSL-00002/6) and then to the HLW melter process (HMP) system.

- Controls developed to prevent or mitigate equipment malfunction are incorporated into the design. The *Description of HLW Vitrification Bypass Events*, 24590-HLW-PER-PR-03-001 describes the operating conditions that require interlocking with the melter feed involve individual components within the offgas system that could result in over pressurization of the melter.

The HLW GFR system contains glass former feed hoppers, located at the 58 ft. elevation of the HLW vitrification plant, that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from transporters. The transporters are located in the glass formers' room within the balance of facilities building.

The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers. The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers. The load cells also confirm that the glass formers are transferred out of the feed hoppers to the melter Feed Preparation Vessels (HFP-VSL-00001/5).

Following the blending cycle, the glass formers are gravity-fed with a rotary feeder into the melter Feed Preparation Vessels (HFP-VSL-00001/5), where the blended glass formers are mixed with the waste feed. This equipment is located in an isolated area that serves as a contamination barrier between the Feed Preparation Vessels (HFP-VSL-00001/5) and the glass former supply. The rotary valve controls the rate of glass former addition into the Feed Preparation Vessels (HFP-VSL-00001/5).

~~The HLW melter feed consists of the following:MM~~

- ~~HLW Cave Receipt Process System (HCP)~~
- ~~HLW Melter Feed Process System (HFP)~~

~~provided~~
~~The primary function of this system is to receive HLW feed slurry from the pretreatment plant, mix glass formers with HLW feed to form a uniform blend, and provide a blended feed to the HLW melter. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste.~~

~~The HLW melter feed system contains the following equipment:~~

- ~~Two concentrate Receipt Vessels (V31001 and V31002)~~
- ~~Glass former feed hopper~~
- ~~Feed Preparation Vessel (V31101)~~
- ~~HLW melter Feed Vessel (V31102)~~

~~The two Concentrate Receipt Vessels, located in a wet process cell, receive HLW concentrate from the pretreatment plant. Process control samples are collected from these vessels and analyzed to determine the glass former formulation. Typically, the concentrate receipt vessels are operated in opposite cycles, where one vessel is filled and sampled while the other is being emptied. After completion of sample analysis, a batch of waste is transferred to the Feed Preparation Vessels for blending with glass formers from the glass former feed hopper. The glass former feed hopper receives blended glass formers and reductant (such as silica, boric acid, calcium silicate, ferric oxide, lithium carbonate, and sucrose) from the HLW glass former feed room. After the blending, the glass formers are gravity-fed into the feed preparation vessel, where the blended glass formers are mixed with the HLW concentrate to form a uniform slurry. The slurry is then fed to the HLW Melter Feed Vessels and then to the HLW melter process system (HMP).~~

~~Instrumentation, alarms, controls, and interlocks will be provided for the HCP and HFP to indicate or prevent the following conditions:~~

- Vessel overflow
- Loss of vessel integrity
- Loss of cooling water flow
- Loss of agitator function
- Agitator not operated at low liquid level to prevent agitator and/or vessel damage
- High or low pressure, temperature, and/or Level

Controls developed to prevent or mitigate accident conditions are incorporated into the design. Operating conditions that have been identified that require interlocking with the melter feed involve individual components within the offgas system that could result in overpressurization of the melter. These operating conditions include:

- Failure of standby offgas duct butterfly valve to open in response to melter surge
- Insufficient airflow to film cooler or blockage of film cooler

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4.1.4.2 HLW Melter Process (HMP) System

Figure 4A-27 presents a simplified process flow diagram of the HLW melter process (HMP) system. The primary functions of this miscellaneous treatment sub-system are to convert blended waste feed and glass formers into molten glass, deliver molten glass to HLW canisters, fill the canisters with molten glass waste, and monitor and control glass waste level during waste filling. The following melter process system, HMP, is identical for both HLW Melters (HMP-MLTR-00001/2).

The HMP system includes the HLW Melters (HMP-MLTR-00001/2), two discharge chambers and two pour spouts per melter, and primary and secondary canister level detection systems. The melter and pour spout will be remotely operated in a C5/R5 cell. There will be no personnel access to this cell after processing of the HLW feed stream begins.

HLW Melters (HMP-MLTR-00001/2)
The two HLW Melters (HMP-MLTR-00001/2), located in melter cave no. 1 and melter cave no. 2, respectively, are rectangular in shape with an outer steel casing. Each is lined with refractory material designed to withstand corrosion by molten glass. The steel casing for the melter area is provided with water cooling to maintain a thermal gradient in the bricks for corrosion control, prevent migration of glass through the bricks, and reduce heat load to the process cell. The lid of the HLW Melter will be sealed to the melter shell in order to provide gas containment. The lid will provide a support structure through which subcomponents can be mounted. Penetrations are sealed by appropriate fittings that allow remote removal and replacement.

Waste feed will be introduced to the melter as a slurry through nozzles in the melter lid. Each feed nozzle will be individually supplied from a slurry pump. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the molten glass. As the slurry is fed, molten glass is formed that accumulates in the glass tank. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. The molten glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks. The rate of feed addition to the melter determines the cold cap coverage in the melt pool. The feed addition rate can be controlled based on the average plenum temperature measured by thermocouples mounted in the melter lid. Air injectors may be used to mix and agitate the molten glass. When the melt level rises to a predetermined upper limit, it is discharged to a canister.

Each Melter (HMP-MLTR-00001/2) includes three important regions: the glass pool, two discharge chambers, and a plenum just above the glass pool. Melter pool level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels. Each discharge chamber is a heavily insulated box on the south side of the melter, housing the discharge trough and a connection flange for the pour spout assembly. The plenum is lined with refractory to withstand hot corrosive gases, thermal shock, and slurried waste splatter.

The power to the electrodes is regulated by the process control system to maintain the temperature at the set point value. The heat for the HLW Melter startup is provided by temporarily installed radiant electric heaters mounted on the lid of the melter. These heaters melt the glass formers sufficiently to make it ionically conductive between the Melter's joule heating electrodes. When a conducting path is established, the Melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time the Melter reaches its operating temperature (generally in the range of 1100°C to 1200°C) and slurry feeding can start. As the slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a canister.

The gas produced during melting is mainly steam and contains volatile components and airborne matter that require removal prior to discharge to the atmosphere. This offgas is diluted by air from four sources; inadvertent air in-leakage through the Melter lid and discharge port, instrumentation and sparging, film cooler air, and air added to control the Melter vacuum. The Melter plenum is maintained at a vacuum with offgas system blowers and control injection of air into the offgas line near the Melter exhaust. This assures containment and avoids Melter pressurization. This vacuum is sensed at a location near the plenum where blockage and feed splatter is unlikely. The sensed vacuum is used to drive a control valve that regulates the draft in the Melter exhaust line.

The glass level in the Melters (HMP-MLTR-00001/2) is maintained between the top of the upper electrodes and below the upper edge of the tank blocks. The level is determined directly by two bubbler tubes that indicate density and glass depth. Thermocouples housed in thermowells that penetrate the cold cap and are immersed in the molten glass also indicate molten glass level. Level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels.

Glass Discharge System

Discharge is achieved by transferring glass from the bottom of the melt pool up through a riser and out of the Melter through a side discharge chamber. Under each of the two discharge chambers there is a pour spout that connects the Melter discharge chamber to the respective HLW canister.

The glass level in the Melter is maintained between the top of the electrodes and the overflow level of the discharge trough. The Melter glass pool level will be measured to indicate when to start and stop glass discharge. Each Melter has two independently operated glass discharge systems, adjacent to each other on one side of the Melter. Each system includes an airlift riser, an airlift lance, a glass pour trough, and a heated discharge chamber. Glass is discharged by introducing gas into the molten glass in the discharge riser. The gas increases the level in the riser, causing the molten glass to flow down the trough and fall from the tip of the trough into the canister. When the desired level in the canister is reached, the air lift gas is turned off, and the glass level in the riser recedes stopping the flow of glass to the canister. During pouring operations, a remote camera is used to view the pour stream within the pour spout assembly. The camera is for observation only and is not a regulated operation.

Level Detection

The purpose of each canister level detection system is to monitor the molten glass level within the HLW canister and to prevent canister overfilling. During glass pour, the level detection system is used to monitor the glass level to ensure the canister is filled to the desired level. The level detection system also will be able to monitor the rate at which the glass level is rising in the canister. There is a primary and a secondary monitoring system, which is consistent with standard vessel level control. A primary system that operates through the process control system is used for normal operations, and a secondary "hard-wired" system is used to back up the primary system and automatically shut down the fill before the overflow limit is reached. The primary level detection system is a thermal imaging system that provides continuous level monitoring over the entire canister. In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system will indicate a filled canister.

During glass pour, the level detection system will display a thermal image on a monitor and will utilize a serial connection to interface with the process control system for indication and control purposes. The imaging software will be used to continuously monitor the level of glass in the canister and will provide an output of the glass level to control loops in the process control system. A high-level condition will be indicated by the process control system, which will initiate alarms and/or control sequences to control the melter pour. The infrared image will be available through the plant closed circuit television system. The control system will be able to store the level of the glass in a canister between batch pours when the temperature in the canister could be cooled down sufficiently to prevent the thermal imaging system from detecting the glass level. The level is reset to zero with each new canister. The control system will also be used to monitor the average temperature of the glass near the top of the pour. If the temperature is lower than a set point value, an alarm will be initiated by the process control system.

Another function of the system is to detect the rate at which the glass level is rising in the canister. This gives an indication of deviation between expected normal pour rates. Deviation could indicate a malfunction of the glass discharge system, and an alarm would be initiated.

In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system would prevent a canister overfill. This system is designed only to detect a discrete high glass level, producing a contact closure when the high level is sensed. When the high level has been reached, the system will automatically shut down the melter gas lift which, in turn, will stop the glass pour. The system is limited to discrete levels of glass fill, not continuous monitoring.

Instrumentation, alarms, controls, and interlocks will be provided for the HMP system to indicate or prevent the following conditions:

- The melter cannot pour without verification that the bogie is present
- The melter cannot pour without verification that the canister is present
- The melter cannot pour if the canister is greater than 95% full

~~The primary functions of this system are to convert blended waste feed and glass formers into molten glass, deliver molten glass to HLW canisters, fill the canisters with molten glass waste, and monitor and control glass waste level during waste filling.,,~~

~~The HMP includes the HLW Melters, two pour spouts, and primary and secondary canister level detection systems. The melter, pour spout, and level detection will be remotely operated in a C5/R5 cell. There will be no personnel access to this cell after hot processing of the HLW feed stream begins.~~

~~HLW Melter~~

~~The HLW Melter, located in the melter cell near the south wall, is a rectangular tank with an outer steel casing. The tank is lined with refractory material designed to withstand corrosion by molten glass. The steel casing for the melter area is provided with water cooling to maintain a thermal gradient in the bricks for corrosion control, prevent~~

migration of glass through the bricks, and reduce heat load to the process cell. The lid of the HLW Melter will be sealed to the melter shell in order to provide gas containment. The lid will provide a support structure through which sub-components can be mounted. Penetrations, primarily on the lid, through the outer shell are sealed by appropriate fittings that allow remote removal and replacement.

The feed is introduced to the melter through a tube that ends at the top of the feed nozzle. The feed nozzle is insulated to prevent drying the feed before it reaches the melter. Water flushes will be used to clear the feed lines as necessary. Feed will be introduced to the melter as a slurry through nozzles in the melter lid. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the *cold cap*. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt. Air injectors may be used to mix and agitate the molten glass. The slurry is fed at a constant rate to each melter. As the slurry is fed, molten glass is formed that accumulates in the glass tank. When the melt level rises to a predetermined upper limit, it is discharged to a container. The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. Each feed nozzle will be individually supplied from a slurry pump. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, and can be controlled based on the average plenum temperature. The glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks.

The Melter includes three important regions: the glass pool, two discharge chambers, and a plenum just above the glass pool. Melter pool level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels. Each discharge chamber is a heavily insulated box on the south side of the melter, housing the discharge trough and a connection flange for the pour spout assembly. The plenum is lined with refractory to withstand hot corrosive gases, thermal shock, and slurried waste splatter. The power to the electrodes is regulated by the PCS to maintain the temperature at the set point value.

The heat for the HLW melter startup is provided by temporarily installed radiant electric heaters mounted on the lid of the melter. These heaters melt the glass formers sufficiently to make it ironically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as *joule heating*). After some time the melter reaches its operating temperature (generally in the range of 950 °C to 1,250 °C) and slurry feeding can start. As the slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a container.

~~The gas produced during melting is mainly steam and contains volatile components and airborne matter that require removal prior to discharge to the atmosphere. This offgas is diluted by air from four sources; inadvertent air in-leakage through the melter lid and discharge port, instrumentation and sparging, film cooler air, and air added to control the melter vacuum. The melter plenum is maintained at a vacuum with offgas system blowers and control injection of air into the offgas line near the melter exhaust. This assures containment and avoids pressurization. This vacuum is sensed at a location near the plenum where blockage and feed splatter is unlikely. The sensed vacuum is used to drive a control valve that regulates the draft in the melter exhaust line.~~

~~The glass level in the Melter is maintained between the top of the upper electrodes and below the upper edge of the tank blocks. The level is determined directly by two bubbler tubes that indicate density and glass depth. Thermocouples housed in thermowells that penetrate the cold cap and are immersed in the molten glass also indicate molten glass level. Level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels.~~

~~Glass Discharge System~~
~~Discharge is achieved by transferring glass from the bottom of the melt pool up through a riser and out of the melter through a side discharge chamber. Under each of the two discharge chambers there is a pour spout that connects the melter discharge chamber to the respective HLW canister.~~

~~With the pour spout assembly retracted and its slide gate closed, a canister is moved into position under the pour spout. The pour spout slide gate seals the opening, preventing large quantities of air from entering the melter and preventing glass drips from falling into the canister tunnel. When a canister is in position under the pour spout, the pour spout is lowered into position by extending the pour spout bellows. The slide gate is then opened and glass drips or fibers collected on the slide gate, while the pour spout assembly was in standby, will be scraped off into the canister. After verification of the slide gate and pour spout positions, the canister is ready to receive glass. During pouring operations, a remote camera is used to view the pour stream within the pour spout assembly.~~

~~The canister level detector monitors the glass fill height and is used to control the molten glass level within the HLW canister, as it is poured from the melter. Once the canister is filled, pouring is terminated and the canister is allowed to cool. After cooling, the slide gate closes and the pour spout lifts away from the canister, compressing the pour spout bellow. After verification of the slide gate and pour spout positions, the canister is transported to the lidding assembly.~~

~~As the canister is transported to the lidding assembly, a standby canister is placed under the pour spout and the pour spout is lowered into position by extending the pour spout~~

bellows to create a metal-to-metal seal with the standby canister. The slide gate is then opened and glass drips or fibers collected on the slide gate while the pour spout assembly was in standby will be scraped off into the standby canister. When a new canister is ready to be placed under the pour spout, the process is repeated again.

Level Detection

The purpose of each canister level detection system is to monitor the molten glass level within the HLW canister and to prevent canister overfilling. During glass pour, the level detection system is used to monitor the glass level to assure the canister is filled to the desired level. The level detection system also will be able to monitor the rate at which the glass level is rising in the canister. There is a primary and a secondary monitoring system, which is consistent with standard vessel level control. A primary system that operates through the PCS is used for normal operations, and a secondary "hard-wired" system is used to back up the primary system and automatically shut down the fill before the overflow limit is reached. The primary level detection system is a thermal imaging system that provides continuous level monitoring over the entire canister. In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system shall indicate a filled canister.

During pour, the level detection system will display a thermal image on a monitor in the central control room and will utilize a serial connection to interface with the PCS for indication and control purposes. The imaging software will be used to continuously monitor the level of glass in the canister and will provide an output of the glass level to control loops in the PCS. A high-level condition will be indicated by the PCS, which will initiate alarms and/or control sequences to control the melter pour. The infrared image will be available through the plant closed circuit television system. The control system will be able to store the level of the glass in a canister between batch pours when the temperature in the canister could be cooled down sufficiently to prevent the thermal imaging system from detecting the glass level. The level is reset to zero with each new canister. The control system will also be used to monitor the average temperature of the glass near the top of the pour. If the temperature is lower than a set point value, an alarm will be initiated by the PCS.

Another function of the system is to detect the rate at which the glass level is rising in the canister. This gives an indication of deviation between expected normal pour rates. Deviation could indicate a malfunction of the glass discharge system, and an alarm would be initiated.

In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system shall prevent a canister overfill. This system is designed only to detect a discrete high glass level, producing a contact closure when the high level is sensed. When the high level has been reached, the system will automatically shut down the melter gas lift which, in turn, will stop the glass pour. The system is limited to discrete levels of glass fill, not continuous monitoring.

Instrumentation, alarms, controls, and interlocks will be provided for the HMP to indicate or prevent the following conditions:

- The slide gate cannot be opened without verification that the pour spout is attached to a canister
- The melter cannot pour glass without verification that the slide gate is open
- The melter cannot pour without verification that the bogie is present
- The melter cannot pour without verification that the canister is present
- The melter cannot pour if the canister is greater than 95% full

4.1.4.3 Melter Offgas Treatment Process (HOP) System

The HOP system is composed of tanks and miscellaneous treatment sub-systems, separated into the primary and secondary melter offgas treatment systems. The HLW Melter Offgas Treatment Process System (HOP) consists of the following subsystems:

Melter offgas is generated from the vitrification of HLW in the joule-heated ceramic melter. The rate of generation of gases in the melter is dynamic and not steady state. Each HLW Melter (HMP-MLTR-00001/2) generates offgas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the offgas include:

- Nitrogen oxides from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- Dangerous waste metals
- Dangerous waste organics
- Particulates and aerosols
- Entrained feed material and glass

In addition, the HLW Melter generates small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. The carbon-14 and tritium emissions are in the form of CO_2 and water respectively.

The purpose of the HOP is to cool and treat the melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the plant. The design of the melter offgas system must accommodate changes in offgas flow from the Melter without causing the melter to pressurize.

Initial decontamination of offgas from the melter is provided by the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of seven times steam flow and three times non-condensable flow from feed. The primary system consists of a film cooler, submerged bed scrubber, a wet electrostatic precipitator, and a high efficiency mist eliminator. This system cools the offgas and removes particulates.

Additionally, an extra line from the Melter to the Submerged Bed Scrubber is provided in the unlikely case that the primary offgas line plugs. This extra line includes a valve as the isolation device. As soon as the melter vacuum decreases to a set point, the valve is actuated and offgas flow is allowed through the line to the Submerged Bed Scrubber, thereby preventing melter pressurization. In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the offgas to the melter cell.

The vessel ventilation header joins the primary offgas system after the Wet Electrostatic Precipitator. After the high efficiency mist eliminatorF, the offgas is routed to the secondary offgas treatment system. The offgas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.

The secondary offgas system (after the HEPA filters to final discharge) is designed to handle maximum sustained flowrate from the melter. The secondary offgas system consists of the following major components:

- Heat recovery unit
- Exhauster fans (two sets)
- Catalytic oxidizer/reducer unit
- Electric preheater
- Iodine absorption column
- Submerged bed scrubber condensate collection vessel (V32101)

The following sections provide descriptions of major melter offgas treatment components MM:

In addition, the HLW Melters (HMP-MLTR-00001/2) generate small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. The carbon-14 and tritium emissions are in the form of carbon dioxide and water, respectively.

The HOP system is divided into a primary system and a secondary system. The purpose of the HOP system is to cool and treat the Melter offgas and vessel ventilation offgas to a level that is protective of human health and the environment. The offgas system must also provide a pressure confinement boundary that will control Melter pressure and prevent vapor release to the plant. The design of the melter offgas system must accommodate changes in offgas flow from the Melter (HMP-MLTR-00001/2) without causing the melter to pressurize.

Initial decontamination of offgas from the melter is provided by the primary offgas treatment system. This primary offgas system is designed to handle intermittent surges of seven times steam flow and three times non-condensable flow from feed. The primary system consists of a film cooler, submerged bed scrubber, a wet electrostatic precipitator, a high efficiency mist eliminator, and high efficiency particulate air (HEPA) filters. This system cools the offgas and removes particulates.

Additionally, an extra line from the Melter (HMP-MLTR-00001/2) to the Submerged Bed Scrubber (HOP-SCB-00001/2) is provided in the unlikely case that the primary offgas line plugs. This extra line includes a valve as the isolation device. As soon as the Melter vacuum decreases to a set point, the valve is actuated and offgas flow is allowed through the line to the Submerged Bed Scrubber, thereby preventing melter pressurization. In the event that the Melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the offgas to the melter cave. Offgas from the Melter cave is drawn through HEPA Filters to remove particulates and discharged to the atmosphere. Once the Melter pressure is back to the desired set point, the valve closes.

The vessel ventilation system offgas consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents. The vessel ventilation header joins the primary offgas system after the Wet Electrostatic Precipitators (HOP-WESP-00001/2). After the HEPA Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B), the offgas is routed to the secondary offgas treatment system.

The following sections provide descriptions of major melter offgas treatment components and are identical for both Melter 1 (HMP-MLTR-00001) and Melter 2 (HMP-MLTR-00002).

4.1.4.3.1 Primary Melter Offgas Treatment (HOP) System

DWP Attachment 51, Appendix 10.1 contains a process flow diagrams of the primary melter offgas treatment process (HOP) system (24590-HLW-M5-V17T-P0003 and 24590-HLW-M5-V17T-P20003). The purpose of the primary offgas treatment system is to cool the melter offgas and to remove offgas aerosols and particulates generated by the Melter (HMP-MLTR-00001/2) and from the vessel ventilation air. This treatment system consists of the following:

Tank System

- SBS Condensate Receiver Vessels (HOP-VSL-00903/4)

Miscellaneous Treatment Unit Sub-Systems

- Film Coolers (HOP-FCLR-00001/2)
- Submerged Bed Scrubbers (HOP-SCB-00001/2)
- Wet Electrostatic Precipitators (HOP-WESP-00001/2)
- High-Efficiency Mist Eliminators (HEME)(HOP-HEME-00001A/1B/2A/2B)
- Electric Heaters (HOP-HTR-00001B/2A/5A/5B)
- High Efficiency Particulate Air (HEPA) Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)

Film Coolers (HOP-FCLR-00001/2)
The function of the Film Cooler (HOP-FCLR-00001/2) is to cool the offgas and entrained molten glass droplets below the glass sticking temperature to minimize glass deposition on the offgas piping walls. The offgas exits the Melter (HMP-MLTR-00001/2) and is mixed with air in the offgas Film Cooler. The Film Cooler is a double-walled pipe designed to introduce injected gas axially along the walls of the offgas pipe through a series of holes or slots in the inner wall. Each melter has a single Film Cooler.

A mechanical reamer may be mounted on the Film Cooler (HOP-FCLR-00001/2) to periodically remove solids build-up on the inner film cooler wall. The reaming device (wire brush or drill) would be periodically inserted into the film cooler for mechanical solids removal.

Submerged Bed Scrubber (HOP-SCB-00001/2)
The offgas from the HLW melter Film Cooler (HOP-FCLR-00001/2) enters the Submerged Bed Scrubber (HOP-SCB-00001/2) for further cooling and solids removal. The Submerged Bed Scrubber is a passive device designed for aqueous scrubbing of entrained particulate from melter offgas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the offgas to a desired discharge temperature through the use of cooling coils/jacket. The offgas leaves the Submerged Bed Scrubber in thermal equilibrium with the scrubbing solution.

The Submerged bed Scrubber (HOP-SCB-00001/2) has one offgas inlet. The offgas enters the Submerged Bed Scrubber through the inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate, creating a lower skirt to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the Submerged Bed Scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected offgas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through cooling coils/jacket.

To maintain a constant liquid level within the Submerged Bed Scrubber (HOP-SCB-00001/2), it will be equipped with an overflow line that allows for the continuous discharge of offgas condensate and some scrubbed particulates to the SBS Condensate Receiver Vessels (HOP-VSL-00903/4). The SBS Condensate Receiver Vessels are also equipped with a cooling jacket. The rate of condensate discharge is determined by how much the offgas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the SBS Condensate Receiver Vessel. To minimize the buildup of the solids in the bottom of the Submerged Bed Scrubber, condensate from the SBS Condensate Receiver Vessels (HOP-VSL-00903/4) will be re-circulated back to the Submerged Bed Scrubber and injected through multiple lances to agitate and suspend solids on the Submerged Bed Scrubber vessel floor. The collected solids will then be pumped directly off the Submerged Bed Scrubber vessel floor to the Plant Wash and Drains Vessel (RLD-VSL-00008). This purging and recycling process occurs simultaneously. Venting of this condensate receiver vessel is via the submerged bed scrubber into the main offgas discharge pipe.

The scrubbed offgas discharges through the top of the submerged bed scrubber and is routed to the Wet Electrostatic Precipitator (HOP-WESP-00001/2) for further particulate removal.

Wet Electrostatic Precipitator (HOP-WESP-00001/2)

The Submerged Bed Scrubber offgas is routed to the Wet Electrostatic Precipitator (HOP-WESP-00001/2) for removal of aerosols down to and including submicron size. The offgas enters the unit and may pass through a distribution plate. The evenly distributed saturated gas then flows up through the tubes which act as the positive electrodes. Each of these tubes has a single negatively charged electrode, which runs down the centerline of each tube. A high-voltage, direct current transformer supplies the power to the electrodes. A strong electric field generated along the electrodes gives a negative charge to the aerosols. The negatively charged particles move toward the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. As the gas passes through the tubes, the first particles captured are the water droplets. As the water droplets gravity drain through the electrode tubes the collected particles are washed off and the final condensate is collected in the wet electrostatic precipitator dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution is routed to the SBS Condensate Receiver Vessels (HOP-VSL-00903/4).

High-Efficiency Mist Eliminators (HOP-HEME-00001A/1B/2A/2B)

Further removal of aerosols is accomplished using the High-Efficiency Mist Eliminator (HEME). The HEMEs also reduce the dust-loading rate on the HEPA filters. Each HEME is essentially a high-efficiency demister that has a removal efficiency of greater than 99% for aerosols down to the submicron size. As the offgas passes through the HEME (HOP-HEME-00001A/1B/2A/2B), the liquid droplets and other aerosols within the offgas interact with High-Efficiency Mist Eliminators' filaments. As the aerosols contact the filaments they adhere to the filaments surface by surface tension. As the droplets agglomerate and grow, they eventually acquire enough mass to fall by gravity to the bottom of the unit, thus overriding the original surface tension, friction with the filaments, and the gas velocity. These collected droplets are assumed to contain the majority of the offgas radioactivity and will be collected in the bottom of the High-Efficiency Mist Eliminators (HOP-HEME-00001A/1B/2A/2B). The collected condensate will gravity drain into the SBS Condensate Receiver Vessel (HOP-VSL-00903/4). As the condensate flows down through the filter bed, a washing action is generated that will help wash collected solids from the filter elements. However, some solids may accumulate in the bed over time, causing the pressure drop across the filter to increase. When the pressure drop across the High-Efficiency Mist Eliminators reaches a predefined level, it is washed with water to facilitate removal of accumulated solids. Some insoluble solids may remain, and their accumulation will eventually lead to the replacement of the High-Efficiency Mist Eliminators' filter elements.

HEPA Electric Heaters (HOP-HTR-00001B/2A/5A/5B) and Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B)
Next, the offgas is heated using an HEPA Electric Heaters (HOP-HTR-00001B/2A/5A/5B) to a temperature above the gas streams dew point and then passed through dual set of HEPA Filters (HOP-HEPA-00001A/1B/2A/2B/7A/7B/8A/8B) to provide high-efficiency submicron removal. The offgas is heated to avoid condensation in the HEPA Filters. When the differential pressure drop across the filters becomes too high, they will be remotely changed out. The system is composed of two parallel HEME/Electric Heater/HEPA Filter trains. The offgas passes through one train while the other remains available as an installed backup.

Maintenance Ventilation Bypass
A maintenance bypass will also be installed, allowing the Melter offgas to bypass the Film Cooler (HOP-FCLR-00001/2), the Submerged Bed Scrubber (HOP-SCB-00001/2), and the Wet Electrostatic Precipitator (HOP-WESP-00001/2). The bypass line would feed into the HEME/HEPA filtration and other gas cleaning steps. Prior to initiating use of the maintenance ventilation line, waste feed would be secured, and the melter placed into an idle condition. No waste feed would be fed to the affected melter when the maintenance ventilation line is in use. The *Description of HLW Vitrification Bypass Events*, 24590-HLW-PER-PER-03-001, provides additional information on HLW bypass events.

4.1.4.3.2 Secondary Offgas Treatment (HOP) System

There is one secondary offgas treatment train for each HLW Melter. The combined primary offgas stream and vessel ventilation offgas stream is discharged to the secondary offgas treatment system. The secondary offgas system will treat the combined offgas to a level protective of human health and the environment. Specifically, the secondary offgas treatment system will remove radioactive iodine, volatile organic compounds, and acid gases, as required, to meet the facility's air discharge requirements. The secondary offgas treatment system consists of the following miscellaneous treatment sub-systems:

- Activated Carbon Columns (HOP-ADBR-00001A/1B/2A/2B)
- Silver Mordenite Columns (HOP-ABS-00002/3)
- Offgas Organic Oxidizers (HOP-SCO-00001/4)
- Selective Catalytic Reducers (HOP-SCR-00001/2)
- Heat Exchangers (HOP-HX-00001/2/3/4)
- Booster Fans (HOP-FAN-00001A/1B/1C/9A/9B/9C)
- Stack Fans (HOP-FAN-00008A/8B/8C/10A/10B/10C)
- HLW stack.

Activated Carbon Column (HOP-ADBR-00001A/1B/2A/2B)
The Activated Carbon Column miscellaneous treatment sub-system removes volatile mercury from the offgas. The activated carbon column will contain a total of four beds (two per Melter). The offgas normally flows through both beds in series. When gaseous mercury is detected breaking through the leading bed, the offgas flow is manually changed to make the trailing bed the leading bed, and only one column is used while the exhausted bed is removed and replaced. The flow is then changed to make the fresh bed the trailing bed.

The activated carbon particles are batch loaded into the bed by gravity. The spent activated carbon is batch removed by gravity and a pneumatic conveyor for collection in canisters. A water fire suppression system is included as a precaution against activated carbon fires.

Silver Mordenite Columns (HOP-ABS-00002/3)
Two Silver Mordenite Column assemblies (one for each Melter) will be located in the HLW vitrification plant. The Silver Mordenite Columns will be used to remove gaseous radioactive iodine (I-129) and other gaseous halogens, such as fluorine and chlorine. The Silver Mordenite Columns (HOP-ABS-00002/3) will consist of approximately 36 silver mordenite adsorbers mounted in a bank configuration to a mounting frame within a housing. Offgas will enter the upper (or inlet) plenum of each Silver Mordenite Column, flow in parallel through the adsorbers to the lower (or exit) plenum, pass through a replaceable roughing filter, and exit. The columns' design will allow manual removal and replacement of adsorbers. Adsorbers will be sized to fit into standard 55 gallon waste drums for disposal.

The silver mordenite adsorbers are essentially cartridges filled with silver mordenite. Silver mordenite is a silver zeolite adsorption media in the form of cylindrical pellets. Halogens will react with the silver in the bed and become trapped within the matrix. Halogens are not loaded uniformly within the Silver Mordenite Adsorber cartridges.

Adsorption reactions occur within an action zone (or mass transfer zone) that varies in length depending on the temperature of the bed and the gas velocity through the bed. Halogens will begin loading at the beginning of the silver mordenite beds and progressively load the silver through the column until breakthrough is reached at the end of the column. Once halogen breakthrough occurs or a predetermined lifespan is reached, the silver mordenite adsorbers will require replacement.

Offgas Organic Oxidizer (HOP-SCO-00001/4) and Selective Catalytic Reducer (HOP-SCR-00001/2)

The offgas is passed through catalytic oxidizer/reducer skids (HOP-SCO-00002/3) housing a heat recovery exchanger (HOP-HX-00001/3), an electric heater (HOP-HTR-00001/7), VOC catalyst (HOP-SCO-00001/4), and SCR catalyst (HOP-SCR-00001/2) miscellaneous treatment unit sub-systems to remove volatile organics compounds, carbon monoxide, nitrogen oxide compounds, and acid gases in the offgas stream.

The heat recovery exchange first raises the offgas temperature using the hot offgas from the catalyst beds. The electric heater is used to supplement the heat recovery exchange primarily during start-up and when operating with low NO_x concentrations. The heated offgas is passed through the VOC catalyst to oxidize VOCs and carbon monoxide to carbon dioxide and water vapor. The offgas is then injected with a mixture of ammonia vapor and C3 air from an ammonia/air dilution skid. Following ammonia injection, the offgas is passed through the SCR catalyst to reduce NO_x to nitrogen and water vapor. The reduction reaction is exothermic, significantly increasing the offgas temperature. The outgoing hot offgas is cooled down in the heat exchanger and concurrently serves as the heating media for the incoming offgas. The cooled offgas stream is then directed to the exhaust stack.

4.1.4.4 Process Vessel Vent (PVV) System

The process vessel vent system consists of vessel ventilation piping and the header that is combined with the primary offgas treatment system. The vessel ventilation header joins the primary offgas system after the Wet Electrostatic Precipitators (HOP-WESP-00001/2) prior to entering high efficiency mist eliminators (HOP-HEME-00001A/B/2A/B). The vessel ventilation system offgas consists primarily of air, water vapor, and minor amounts of aerosols generated by the movement of vessel contents.

The process vessel vent system provides a vacuum on connected vessels relative to the host cell. The vacuum is controlled by an automatic pressure control valve system on the vessel vent header. The vessels attached to the vessel vent system are the melter feed and feed preparation vessels (HFP-VSL-00001/2/5/6), waste neutralization vessel (HDH-VSL-00003), acidic waste vessel (RLD-VSL-00007), the plant wash and drains vessel (RLD-VSL-00008) indirectly via the acidic waste vessel, and breakpots.

4.1.4.5 HLW Pulse Jet Ventilation (PJV) System

The PJV system consists of the following miscellaneous treatment sub-systems:

- HEPA Filters (PJV-HEPA-00004A/4B/5A/5B)
- Electric Heaters (PJV-HTR-00002)
- Pulse Jet Fans (PJV-FAN-00002A/B)

The PJV system draws exhaust air from selected HLW vessels, primarily those that use fluidic equipment, pulse jet mixers (PJMs) and reverse flow diverters (RFDs), for mixing and transfer of process fluids out of vessels for processing or sampling. Fluidic equipment use a column of air to lift and drop the liquid level in PJM or RFD vessels, which are located inside process vessels. Fluidic equipment will produce gaseous exhaust air as part of their normal operations. Fluidic exhaust air from individual vessels combines in a common header. Prior to discharge to the atmosphere, the exhaust air is heated in the electric heater (PJV-HTR-00002) to eliminate aerosols and reduce relative humidity of the gas stream and filtered by the HEPA filters (PJV-HEPA-00004A/4B/5A/5B) to remove particulates that may be present. The exhaust air is then pulled through the PJV extraction fans (PJV-FAN-00001A/B) and discharged through a dedicated stack. The HLW vessels attached to the PJV system are SBS condensate receiver vessels (HOP-VSL-00903/904), SBS (HOP-SBC-00001/2), acidic waste vessel (RLD-VSL-00007), plant wash and drains vessel (RLD-VSL-00008) and canister decon vessels (HDH-VSL-00002/4).

4.1.4.6 Radioactive Liquid Waste Disposal (RLD) System

The primary functions of the RLD tank system are to receive, store, and transfer various effluents from different HLW treatment systems. Various operations, such as neutralization, mixing, and sampling of the waste, are performed by these systems as required.

The RLD system contains three tanks located in the HLW vitrification plant wet process cell:

- Acidic Waste Vessel (RLD-VSL-00007)
- Plant Wash and Drains Vessel (RLD-VSL-00008)
- Offgas Drains Collection Vessel (RLD-VSL-00002)

The RLD system receives mixed waste effluent from the HOP system, the HLW canister decontamination handling (HDH) system, and periodic plant and vessel washes within the HLW vitrification plant.

These effluents include the following:

- Purge liquid from the Submerged Bed Scrubbers (HOP-SCB-00001/2)
- Drains from the Wet Electrostatic Precipitators (HOP-WESP-00001/2)
- Drains from the High-Efficiency Mist Eliminators (HOP-HEME-00001A/1B/2A/2B)
- Various plant and vessel washes and sump water
- Miscellaneous mixed waste streams, including vessel vent, bulge, and cabinet drains and canister decontamination effluents

Acidic Waste Vessel (RLD-VSL-00007)
This vessel collects liquid from the Submerged Bed Scrubber (HOP-SCB-00001/2) and the SBS Condensate Receiver Vessel (HOP-VSL-00903/4). The collected liquid waste consists of submerged bed scrubber purge, wet electrostatic precipitator drain, and high-efficiency mist eliminator drain. Sampling will be performed by an automated sample system to characterize the liquid waste. The contents are transferred to the PWD system in the pretreatment plant for treatment, as required.

Plant Wash and Drains Vessel (RLD-VSL-00008)
This vessel collects drains from vessels, sumps, and plant washes within the HLW vitrification plant, including wash water from cell floors, equipment exterior surfaces, stainless steel cladding, and bulges. This vessel also collects the C3 area fire water. Sampling will be performed by an automated sample system to characterize the liquid waste. The contents are transferred to the PWD system in the pretreatment plant for treatment, as required.

Offgas Drains Collection Vessel (RLD-VSL-00002)
This vessel receives condensate from the HOP pipes and PJV drains downstream from the High-Efficiency Mist Eliminator (HOP-HEME-00001A/1B/2A/2B) during off-normal operation. The contents are transferred to the Plant Wash and Drains Vessel (RLD-VSL-00008) in the HLW vitrification plant for processing.

The primary functions of the RLD are to receive, store, and transfer various effluents from different HLW treatment systems for collection and handling.,

The RLD contains four vessels located in the HLW vitrification plant wet process cell:

- Acidic waste vessel (V35002)
- Plant wash and drains vessel (V35003)
- Decontamination effluent collection vessel (V35009)
- Offgas drains collection vessel (V35038)

The RLD receives radioactive effluent from the Melter Offgas Treatment Process System (HOP), the HLW canister decontamination handling (HDH), and periodic plant and vessel washes within the HLW vitrification plant.

- These effluents include the following: submerged bed scrubber purge, wet electrostatic precipitator drain, high efficiency mist eliminator drain, canister decontamination waste, various plant and vessel washes, sump wastes, and miscellaneous radioactive drains, including vessel vent, bulge, and cabinet drains.

The functional purpose of the RLD is to handle liquid waste for interim storage and transfer to pretreatment facilities where the waste is either recycled to the process or sent to the LERF/ETF. Various operations such as neutralization, mixing, and sampling of the waste are performed by these systems as required.

Acidic Waste Vessel
This vessel collects liquid from the submerged bed scrubber and the submerged bed scrubber condensate collection vessel. The collected liquid waste consists of submerged bed scrubber purge, wet electrostatic precipitator drain, and high efficiency mist eliminator drain. Sampling will be performed via an automated sample system to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

Plant Wash and Drains Vessel
This vessel collects washes from vessels, sumps and plant washes within the HLW vitrification plant, including wash water from cell walls, equipment exterior surfaces, stainless steel cladding, and bulges. This vessel also collects the C3 area fire water. Sampling will be performed via an automated sample system to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

Decontamination Effluent Collection Vessel
This vessel receives liquid waste from waste neutralization vessel (V33002). Sampling will be performed via an auto sampler to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

Offgas Drains Collection Vessel
This vessel receives condensate from the HOP ducts downstream from the high efficiency mist eliminator during off-normal operation. The contents are transferred to the plant wash and drains vessel in the HLW vitrification plant.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD to indicate or prevent the following conditions:

- Level indication: Level in the vessel is monitored for process condition and status. High level alarm alerts operators to high-fill condition. High-high level will result in the stop of the incoming transfer. Low level alarm alerts operator to low-fill condition. Low-low level will result in the stop of outgoing transfer.

- Temperature indication: Temperature in the vessel is monitored for process condition and status.
- Density indication: Density is monitored for process condition and status. The density is also used to determine the liquid level.
- Pressure indicator: Vessel vacuum is monitored to assure contaminated vapor containment. The pressure is also used to determine the liquid level.
- Prevent receiving waste when the vessel is at high-high liquid level.
- The pump and mixer are cut-off at low-low liquid level.
- The pump will stop transfer if the destination vessels (in pretreatment or within the HLW vitrification plant) reach high-high liquid level.

4.1.4.7 IHLW Glass Canister Handling Process

The IHLW glass canister handling will consist of the following systems:

- HLW canister receipt handling (HRH) system
- HLW canister pour handling (HPH) system
- HLW canister decontamination handling (HDH) system
- HLW canister export handling (HEH) system

The individual systems and their primary functions are described below:

4.1.4.6.1 HLW Canister Receipt Handling (HRH) System
The primary function of this system is to import clean canisters into the facility. The HRH system consists of the equipment, controls, and interlocks required for importing a clean canister into the plant. This system consists of the canister import truck bay, the canister import room, and the canister import tunnel. and the canister transfer interface into the handling cave. These areas are located on the south side of the plant.

The sequence of operations and the equipment used for canister import are as follows:

- The shipping crates are unloaded from the transport truck with the canister import crane and placed in the staging area.
- The canisters are then individually removed from the shipping crate and set on the canister inspection/rotation table.
- The canister import room roller shutter door is opened and the canister inspection/rotation table rotates the canister to vertical. The canister import monorail hoist and grapple lift and transfer the canister to the canister import room. The canister is either set in the canister import buffer rack or placed in the canister import bogie. When the canister is transferred to the canister import tunnel, the shielded

clean canister import hatch is opened and the canister is lowered into the canister import bogie below, and the hatch is closed and sealed.

- The canister import bogie is transferred under the canister handling cave to the shielded canister handling cave import hatch location. The canister handling cave hatch is then opened and the canister handling cave crane and grapple raises the canister into the canister handling cave. The canister handling cave import hatch is closed and the canister import bogie is returned to under the clean canister import hatch.

Instrumentation, alarms, controls, and/or interlocks will be provided for the HRH system as follows:

- Sealed hatch will be interlocked with canister import room roller shutter door preventing backflow of C3 air into canister import room or truck bay
- Prevent rotation/inspection table from rotating when roller shutter door is closed
- The HRH system will be designed such that only one door or hatch will be open at any one time
- Gamma interlock will be provided to prevent shielded personnel access door in canister import tunnel from being opened when radiation/contamination levels exceed limits or if the canister handling cave import hatch is open
- Gamma interlock will be provided to prevent clean canister import hatch in the canister import room from being opened when radiation/contamination levels exceed limits or if the canister handling cave import hatch is open

HLW Canister Pour Handling (HPH) System The primary functions of the HPH system are to transport empty product canisters and full IHLW canisters within the plant and perform product canister sampling, canister closure, and canister rework activities. The HPH system includes the canister handling cave, which includes two weld stations. The crane decontamination and crane maintenance areas are also part of the HPH system, located west of the canister handling cave. Pour tunnels no. 1 and no. 2, which include the bogie decontamination and maintenance areas, are also part of this system.

The primary functions of this system are to provide equipment to the transport canister, provide equipment for decontamination and maintenance, and provide equipment for remote viewing.

The primary functions of the canister handling cave are as follows:

- Receive canister from HRH system canister receipt handling
- Transport empty canister to import racks
- Transfer empty canister to pour tunnel 1 or 2

- Receive full canister from pour tunnel 1 or 2
- Transport full canister to cooling rack
- Transport canister to weld station
- Transfer canister to HDH system canister decontamination handling
- Provide equipment for canister import and buffer store

This section describes activities that will be performed in HLW pour tunnel no. 1 (H-B032) and pour tunnel no. 2 (H-B005A).

Pour Tunnel

The pour tunnels are at the -21 ft level and extend from north-south beneath the south end of the melter cave to an area below the canister handling cave. Bogie decontamination is performed in the tunnels, and bogie maintenance areas are provided in a designated shielded area at the south end of the tunnels. The tunnels will have a hatch that segregates the pour tunnels and the canister handling cave. The tunnels will also have a bogie maintenance shield door. The bogie maintenance area has a shield personnel access door and a roof access plug from the corridor above. The pour tunnels are designated as C5 areas.

Canister Transport

The HPH system supports both HLW Melters (HMP-MLTR-00001/2). Canisters are transported within the canister handling cave by means of an overhead crane. A standby crane is available in the event of the primary overhead crane failure. Viewing windows and camera are provided for viewing of equipment and operations within the cave area. Integrated networks of programmable logic controllers, which form part of the process control system, are used to control the mechanical handling.

Clean canisters are transferred from the HRH system to the HPH system through the canister import tunnel hatch. The hatch opens and the handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the buffer storage area racks. When a canister is required for filling, it is taken out of the buffer rack using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister is lowered into the pour tunnel bogie below. The grapple is released and raised and the hatch is closed. The bogie travels to a position under the pour spout. As the bogie moves into position under the pour spout, the pour spout glass catch tray is pushed back and signals that a canister is present. A proximity switch detects that the bogie is in position, the bogie is then locked into position, and the canister is filled with glass. Canister filling is controlled and monitored by the canister level detection system (system HMP melter process). After completion of filling, the canister remains at the pour spout for approximately one hour to allow a "skin" to form over the glass that provides a seal to prevent additional offgassing. The filled canister is allowed to cool prior to removal from the pour tunnel. After cooling, the canister is moved south in the pour tunnel until it is beneath the canister handling cave hatch. The hatch is opened, the canister handling cave crane removes the full canister, and the hatch is closed. The filled canister is then cooled in cooling racks in preparation for welding the lid in place.

After cooling, in the cooling racks, a crane transfers the canister for lid welding, sampling of glass, and/or rework. The canister is lowered into the welding station table and the grapple released from the canister. After the welding station operations, the crane transfers the canister to the buffer storage racks or to the decontamination system rinse bogie, via the decontamination hatch.

The canister handling cave is classified as a C5 area; therefore, activities in the handling cave will be conducted remotely. This will be accomplished with viewing windows, cameras, manipulators, and overhead cranes. Windows are strategically located above the transfer hatches for viewing the canisters as they are raised and lowered. The crane decontamination area is located on the west end of the canister handling cave. The decontamination area is classified as a C3/C5 area. The crane maintenance area is located west of the crane decontamination area. The crane maintenance area is classified as a C3 area.

Canister Weld, Glass Sampling, and Rework

The following system supports both HLW Melters (HMP-MLTR-00001/2). The canister lid welding, glass sampling, canister inspections, and rework will be performed at one of two welding stations located along the south wall of the canister handling cave. Each station is located next to a shield window. Master-slave manipulators, closed circuit television, and lights are provided to assist weld station operations.

After the canister is cooled in the canister handling cave, the overhead crane moves the canister from the cooling rack into a port on the welding table. The canister is weighed and confirmed to be below the maximum allowable weight. While the canister is being lowered, cameras inspect the outside of the canister. Typically, glass waste residue is not expected on the exterior of the canister. However, prior to welding the lid on the canister, the canister is inspected. If glass is found on the canister, the glass will be removed using a needle descaler manually operated with the master-slave manipulator. A vacuum system will be used to capture the removed glass and prevent the spread of debris. The canister is then checked to confirm that its temperature is within the allowable range for welding. This is done using a thermocouple at the weld station. Glass samples are collected using a master-slave manipulator-operated glass sampling tool that uses a vacuum to draw shards of glass from the top surface. These shards are then transferred into sample vials and transferred to the laboratory using a pneumatic transfer system.

The lid is placed on the canister and welding is performed using an automated welder. The welding parameters are recorded in the plant tracking system. The finished weld is visually inspected using in-cave inspection cameras. Rejected welds may be repaired by re-melting the weld, mechanically removing the weld and re-welding, or welding a secondary lid over the primary lid. The sealed canister is then transferred to the HDH system.

Instrumentation, alarms, controls, and interlocks will be provided for the HLW canister handling system to indicate or prevent the following conditions:

- The crane decontamination shield doors are interlocked with the crane maintenance shield door to prevent both sets of doors from being open simultaneously.
- Interlocks will prevent the inadvertent access of personnel or equipment movement
- The bogie maintenance shield door is interlocked with the shielded personnel access door to ensure that personnel do not enter the bogie maintenance area when the bogie maintenance shield door is open.
- Radiation monitoring equipment is interlocked to the shielded personnel access door to ensure no personnel are able to access the maintenance area if a radiation/ contamination source above prescribed limits is present.

HLW Canister Decontamination Handling (HDH) System
The primary function of the HLW canister decontamination handling system (HDH) is to decontaminate the IHLW canisters and to swab and monitor IHLW canisters.

The HDH system includes the process and equipment to perform the cerium nitrate canister decontamination process, surface swabbing, and swab monitoring process. The following vessels and their associated ancillary equipment are included in the HDH system:

- Canister Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001)
- Waste Neutralization Vessel (HDH-VSL-00003)
- Canister Decon Vessels (HDH-VSL-00002/4)

The HDH system consists of a canister rinse tunnel, canister decontamination station, swabbing and monitoring station, bogie maintenance areas, crane maintenance area, and canister transfer tunnel. The decontamination system consists of two stations: the decontamination station, which is located in-cave, and a mixing station, which is located out-cave. Vertical separation between the stations facilitates gravity flow of process solutions from the mixing station to the Canister Decon Vessels (HDH-VSL-00002/4). Beneath the canister decon cave is a canister rinse tunnel and a canister storage transfer tunnel. The canister rinse tunnel houses the canister rinse bogie, which transfers the canister from the canister handling cave to the canister decon cave while performing a prewash at an intermediate station. The canister storage transfer tunnel houses the canister storage transfer bogie, which transfers the decontaminated canisters from the canister decon cave to the canister export cave.

A filled, cooled, and welded IHLW canister is initially transported to the HDH system via a crane located in the canister handling cave. The IHLW canister is loaded into the canister rinse bogie and washed in a sealed vessel using low-pressure demineralized water to remove loose contamination. This water wash is performed in the Canister Rinse Tunnel Canister Rinse Vessel (HDH-VSL-00001) mounted on the canister rinse bogie, which travels from below the canister handling cave to below the canister decon cave. After the water wash, the canister is transferred by a crane to the canister decon vessel for further decontamination by chemically etching a thin layer of stainless steel from the canister surface, using cerium ion in a dilute nitric acid. The canister is then washed with nitric acid, followed by a second washing with de-mineralized water. After draining de-mineralized water from the Canister Decon Vessel, the canister remains in the vessel to dry. The decontamination fluids are pumped into a Waste Neutralization Vessel (HDH-VSL-00003) to which hydrogen peroxide is added to neutralize remaining cerium ion. Following neutralization, the fluid is transferred to the plant waste stream, or recycled back into the HLW Melters (HMP-MLTR-00001/2) via the pretreatment plant. The decontaminated canister is transported by overhead crane to the canister swabbing and monitoring area.

After decontamination and drying, the canister is swabbed using an automated power manipulator. If the contamination is below acceptable limits, the IHLW canister is placed into a canister storage transfer bogie located below the canister decon cave floor, and transported to the HLW canister export handling system.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.4, the following will be provided in for the HDH system to indicate or prevent the following conditions:

- Interlocks will be provided on bogie decontamination/maintenance area shield door to protect plant personnel from radiation and contamination exposure.
- Interlocks will be provided on crane maintenance area shield door to protect plant personnel from contamination exposure.

HLW Canister Export Handling (HEH) System
The primary functions of this system are to store filled IHLW canisters in racks, transfer the IHLW canisters into the canister export cave, load the IHLW canisters into product casks, evaluate product casks for contamination, and load IHLW product casks into transport vehicles. The HEH system consists of a canister export cave, a cask handling tunnel, a cask loading area, and a truck bay, and is equipped to support both HLW Melters.

Decontaminated IHLW canisters are transferred to the canister export cave from the HDH system using a bogie and an overhead crane and placed in the canister storage racks. When a IHLW canister is ready for exporting to an appropriate Hanford Site TSD unit, a dedicated transport vehicle is dispatched to the IHLW truck bay. The empty product cask is removed from the vehicle and placed on a cask transfer bogie located in the cask handling tunnel. The bogie transfers the cask to a lid lifting station where the lid is removed, and then to a canister receiving station. The IHLW canister is visually inspected in the canister storage cave and its identification confirmed. After the inspection information is recorded, the canister is lifted by overhead crane and placed into the product cask. The bogie then returns the cask to the lid lifting station where the lid is replaced and bolted. The product cask is then transferred to the export station where the cask is lifted by an overhead crane and placed on the transport vehicle. Swab samples are taken, and when the cask exterior is verified to be below the acceptable radioactive contamination level, the cask is transported to a Hanford Site storage facility.

Closed circuit television cameras will provide general viewing of the canisters and the storage area. Descriptions of inspections of IHLW canister storage areas are included in Chapter 6 of this permit. An IHLW canister tracking system will retain required information such as the IHLW identification number, weight, and dimensions of the IHLW canisters.

In addition to the instrumentation, alarms, controls, and interlocks addressed in section 4.1.4, the following will be provided for the HEH to indicate or prevent the following conditions:

- Interlocks to prevent the canister storage cave import hatch and the canister storage cave export hatch from being open at the same time
- Gamma monitoring and keyed interlocks to prevent the cask export hatch from opening when high radiation levels exist
- Interlock to prevent the canister storage cave export hatch from being open at the same time as the cask export hatch
- Gamma detectors/interlock to prevent cask handling bogie travel to the cask export hatch unless the cask lid is properly installed
- Interlock to prevent both truck bay "exit" and "entrance" (external) roller shutter doors from being open at the same time
- Interlock to prevent the truck bay inner roller shutter door from being open at the same time as either of the "exit" or "entrance" roller shutter doors
- The shielded personnel access door in the canister export cave crane maintenance area is interlocked with the canister export cave crane maintenance horizontal and vertical shield door. The shielded personnel access door is also interlocked with a gamma monitor to prevent opening when a source is present.
- The canister export cave import hatch is interlocked to prevent opening unless the following conditions are satisfied. The canister export cave export hatch is closed. The crane maintenance area shield horizontal and vertical shield doors are closed.

The decontamination cave export hatch is closed. The canister storage transfer bogie is in position under the canister export cave import hatch.

- The canister export cave export hatch is interlocked to prevent opening until the following conditions are satisfied. The canister export cave import hatch is closed. The cask export hatch is closed. The cask handling bogie is under the canister export cave export hatch. The cask handling tunnel shielded personnel access door is closed.
- The process crane is prevented from striking the crane maintenance area shield door by end of travel and over-travel limit switches.

~~The HRH begins at a truck bay where canisters are first brought within the HLW vitrification plant. An import bulge is located in the truck bay on the north wall and on the south side of the import tunnel. The bulge is intended to provide a separate air space between the C1 truck bay, and the C3 import tunnel during canister import.~~

~~An overhead crane, stationed in the truck bay, will unload shipping canisters from the transport truck. The shipping canisters will be placed in the staging area where receiving personnel will inspect the canister packaging for shipping damage. The crane will then remove an individual IHLW canister from the shipping canister and place it on the inspection/rotation table. The lid will be removed, and both the canister and the lid will be inspected for cleanliness, damage, and compliance with new product canister specifications. The canister identification number is assigned and results of inspection are recorded. Each canister will have a unique identification number that will be entered into the plant tracking system to allow tracking of the canister throughout the plant.~~

~~After the canister inspection, the import bulge roller shutter door will be opened and the table will rotate the canister into the vertical position. This is required before introduction into the canister handling cave because all process sequences are designed to handle a vertical canister. The canister lid will be replaced and the overhead monorail hoist and grapple will grab and support the canister while being released from the table. The monorail will lift and transfer the canister into the import bulge. The canister will either be set in the import buffer racks or placed in the import bogie. When the canister is transferred to the import tunnel, the sealed hatch is opened and the canister is lowered into the import bogie below. Once the canister is loaded into the bogie, the grapple is released and withdrawn and the hatch is closed. The bogie is transferred to the canister handling cave. The canister handling cave's shielded hatch is then opened and the canister handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the canister handling cave buffer storage area rack. The canister identification number will be logged in the plant information network as being entered into the process.~~

~~Instrumentation, alarms, controls, and/or interlocks will be provided for the HRH as follows:~~

- Sealed hatch will be interlocked with the shielded hatch
- Personal access door to import tunnel will be interlocked with gamma monitors
- Shielded hatch will be interlocked with roller shutter door preventing back flow of C3 air into truck bay
- Prevent rotation/inspection table from rotating when roller shutter door is closed
- The import tunnel sealed door is interlocked with the import hatch

HLW Canister Pour Handling (HPH) System
The primary functions of this system are as follows:

- Transport IHLW canisters between the canister handling cave and melter pour station
- Provide a transfer router for secondary waste and equipment for decontamination and maintenance
- Transport IHLW empty and filled canisters to interfacing process systems
- Provide cooling buffer storage prior to welding
- Provide lag storage prior to canister decontamination
- Staging empty canisters for filling and full canisters for cooling
- Provide buffer storage of canisters
- Crane decontamination and maintenance
- Export of consumables
- Prepare IHLW canisters for welding
- Weld canister lids
- Provide glass shard sampling
- Inspect canisters
- Rework defective welds

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This section focuses primarily on Pour Tunnel 1; however, Pour Tunnel 2 will be utilized to support a second melter, as necessary. The equipment for Pour Tunnel 2 will be similar to that provided for Pour Tunnel 1 but will be installed later to support the second melter.

Pour Tunnels
The pour tunnels are located south of the melter caves and run in the north-south direction. The bogie and rails extend further under the melter cave under the melter allowing a standby bogie to be positioned under the melter when the process bogie is in the pour position. The rails will be isolated from the melter cave with steel contamination control barriers. The bogie decontamination areas are located south of the melter caves. Viewing windows and master-slave manipulators are provided for each bogieh.

When a canister is required for filling, it is taken out of the buffer rack in the canister handling cave using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister handling cave crane loads the empty canister into the pour tunnel bogie. The grapple is released and raised and the hatch is closed. The bogie travels north to the lidding device. At the lidding device, the primary bogie moves up to the standby bogie and latches onto it. The primary bogie is then in position with the lid removed. The standby bogie is shunted along the track until the primary bogie is in position under the pour spout. The primary bogie is then in position, the pour spout is lowered onto the canister flange, and the canister is filled with glass. Canister filling is controlled and monitored by the canister level detection system.

After completion of filling, the canister remains at the pour spout for approximately one hour to allow a "skin" to form over the glass which provides a seal to prevent additional offgassing. The pour spout is then retracted and the primary bogie is unlocked, and moved back. This sequence also moves the stand-by bogie back under the pour spout. The filled canister is allowed to cool prior to removal from the pour tunnel. The primary bogie is then unlatched from the standby bogie and moved south in the pour tunnel until it is beneath the canister handling cave hatch. The hatch is opened, the canister handling cave crane removes the full canister, and the hatch is closed. The filled canister is then cooled in cooling racks in preparation for welding the lid in place.

Canister Transport
IHLW canisters are transported within the canister handling cave by means of an overhead crane. A standby crane is available in the event of the primary overhead crane failure. Viewing windows and camera are provided for viewing of equipment and operations within the cave area. Integrated networks of programmable logic controllers, which form part of the PCS, are used to control the mechanical handling.

The clean canister is transferred from the HRH to the HPH through the canister import tunnel hatch. The hatch opens and the handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the buffer storage area racks. When a canister is required for filling, it is taken out of the buffer rack using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister is lowered into the pour tunnel bogie below. The grapple is released and raised and the hatch is closed. After the canister is filled with glass, the crane located above the hatch transfers the filled canister to the buffer/cooling rack where it is allowed to cool. After cooling, a crane transfers the canister for welding, sampling, and/or rework. The canister is lowered into the welding station table and the grapple released from the canister. After the welding station operations, the crane transfers the canister back to the cooling racks or to the decontamination system rinse bogie, via the decontamination hatch.

~~The canister handling cave is classified as a C5 area; therefore, most activities in the handling cave will be handled remotely. This will be accomplished with viewing windows, cameras, and overhead cranes. Windows are strategically located above the transfer hatches for viewing the canisters as they are raised and lowered. The crane decontamination area is located on the west end of the canister handling cave. The decontamination area is classified as a C5/C3 area. The crane maintenance area is located west of the crane decontamination area. The crane maintenance area is classified as a C3 area.~~

~~Canister Weld, Glass Sampling & Rework~~
~~The canister lid welding, glass sampling, canister inspections, and rework will be performed at one of two welding tables located along one wall in the canister handling cave. Only one table will be set up with equipment initially, but the second table may be outfitted identically to the first table to support a second melter at a later date. Each table will be set next to a shield window. Master-slave manipulators, closed-circuit television, and lights will be provided when they are required for operations.~~

~~After the canister is cooled in the canister handling cave, the overhead crane moves the canister from the cooling rack into a port on the welding table. The canister is weighed and confirmed to be below the maximum allowable weight. While the canister is being lowered, cameras inspect the outside of the canister. Typically, glass waste residue is not expected on the exterior of the canister. However, prior to welding the lid on the canister, the canister is inspected. If glass is found on the canister, the glass will be removed using a needle descaler manually operated with the master-slave manipulator. A vacuum system will be used to capture the removed glass and prevent the spread of debris. The canister is then checked to confirm that its temperature is within the allowable range for welding. This is done using a thermocouple at the station. Then the lid is removed using a lid lifter, and required inspections, such as glass fill height or foreign debris inside the canister, are performed. Glass samples are collected using an master-slave manipulator-operated glass-sampling tool that uses a vacuum to draw shards of glass from the top surface. These shards are then transferred into sample vials and transferred to the laboratory using a transfer system.~~

~~The lid is placed on the canister and welding is performed using an automated welder. The welding torch has an arc voltage controlled head and the ability to remotely control the torch angle, travel speed, and travel direction. The welding parameters are recorded in the plant tracking system. The finished weld is visually inspected using in-cave inspection cameras. Rejected welds may be repaired by re-melting the weld, mechanically removing the weld and re-welding, or welding a secondary lid over the primary lid. Metal dust and slag resulting from rework will be removed using a localized HEPA vacuum to minimize the spread of contamination. The sealed canister is transferred to the HLW Canister Decontamination Handling System (HDH).~~

Instrumentation, alarms, controls, and interlocks will be provided for the IHLW canister handling system to indicate or prevent the following conditions:

- Zone controls will be employed on the HPH crane to prevent the canister from impacting the welding station during canister transfers. An interlock on the crane will prevent the crane from coming into position over the canister port in the table unless the weld station carriage is positioned out of the way for this movement.
- Carriages will not move when the equipment mounted on the frame is deployed or in operation.
- The crane decontamination shield door is interlocked with the crane maintenance shield door to prevent both doors from being open concurrently.
- The shielded door in the crane maintenance area is interlocked with the crane maintenance shield door. The door is also interlocked with a gamma monitor to prevent opening when a dose is present.
- Process cranes are interlocked such that their hoists can only be lowered at designated positions in automatic mode, and if over hatches, when signal confirms door is in open position.
- Process cranes are interlocked with the hoists such that the cranes can only move with the grapple at transport height.
- The process cranes are interlocked such that they cannot attempt to enter the crane decontamination area unless the crane decontamination shield door is open.
- The bogie maintenance shield door is interlocked with the shielded personnel access door to ensure that personnel do not enter the bogie maintenance area when the bogie maintenance shield door is open.
- Radiation monitoring equipment is interlocked to the shielded personnel access door to ensure no personnel are able to access the maintenance area if a radiation/ contamination source above prescribed limits is present.
- The bogie sleeve detector is interlocked to the bogie maintenance shield door to ensure the sleeve is removed from the bogie before the bogie enters the maintenance area.
- An interlock with ensure that the canister lid has been removed before glass filling can take place.

HLW Canister Decontamination Handling System (HDH)
The primary function of this system is to decontaminate the IHLW canisters, swab and monitor IHLW canisters, and decontaminate the HDH equipment.

The HDH includes the process and equipment to perform the cerium nitrate canister decontamination process, surface swabbing, and swab monitoring process.The IHLW canister will be managed above floor level in the decontamination cave and below floor level in the rinse and transfer tunnels either on a bogie or suspended by crane.

The HDH consists of a canister rinse tunnel, decontamination station, swabbing and monitoring station and canister transfer tunnel. The decontamination station is located in front of a viewing window. The decontamination system consists of two stations: the decontamination station which is located in-cave (canister decontamination vessel, waste neutralization vessel, and two breakpots to waste neutralization tank) and a mixing station (including nitric acid addition tank, cerium addition tank, and hydrogen peroxide addition pot) which is located out-cave. Vertical separation between the stations facilitates gravity flow of process solutions from the mixing station to the decontamination vessel. Beneath the canister decontamination cave is a canister rinse tunnel and a canister storage transfer tunnel. The canister rinse tunnel includes a bogie decontamination and maintenance area and houses the canister rinse bogie which transfers the canister from the canister handling cave to the canister decontamination cave while performing a prewash at an intermediate station. The canister storage transfer tunnel houses the canister storage transfer bogie which transfers the decontaminated canisters from the canister decontamination cave to the canister storage cave.

A filled, cooled, and welded IHLW canister is initially transported to the HDH via a crane located in the canister handling cave. The IHLW canister is loaded onto the canister rinse bogie, and washed in a sealed area using low-pressure demineralized water to remove loose contamination. This water wash is performed in a container mounted on the canister rinse bogie, which travels from below the canister handling cave to below the canister decontamination cave. After the water wash, the canister is transferred by a crane to the decontamination vessel for further decontamination by chemically etching a thin layer of stainless steel from the canister surface, using cerium ion in a dilute nitric acid. The canister is then washed with nitric acid, followed by a second washing with de-ionized water. the canister remains in the vessel to dry, while the decontamination fluids are pumped into a vessel to which hydrogen peroxide is added to neutralize remaining cerium ion. Following neutralization, the fluid is transferred to the plant waste stream and it can be recycled back into the HLW melter via pretreatment. The decontaminated canister is transported by overhead crane to the swabbing area.

After decontamination and drying, the canister is swabbed using an automated power manipulator. If the contamination is below acceptable limits, the IHLW canister is placed into a canister storage transfer bogie located below the canister decontamination cave floor, and transported to the HLW canister export handling system. IHLW canisters that exceed the contamination limits are returned to the decontamination and swabbing station for further processing. Swabbing and monitoring results are recorded.

Instrumentation, alarms, controls, and interlocks will be provided for the HDH to indicate or prevent the following conditions:

- Interlocks will be provided on bogie decontamination/maintenance area shield door to protect plant personnel from radiation and contamination exposure.

- Interlocks will be provided on crane maintenance area shield door to protect plant personnel from contamination exposure.

HLW Canister Export Handling (HEH) System
The primary functions of this system are to provide storage of the IHLW canisters in storage racks, transfer the IHLW canisters into the canister storage cave, load the IHLW canisters onto product casks, evaluate product casks for contamination, and load IHLW product casks into transport vehicles. The HEH consists of a canister storage cave, a cask handling tunnel, a cask loading area, and a truck bay.

The decontaminated IHLW canisters are transferred to the canister storage cave from the HDH using a bogie and an overhead crane and placed in the canister storage racks. When a IHLW canister is ready for exporting to an appropriate Hanford Site TSD unit, a dedicated transport vehicle is dispatched to the IHLW truck bay. The empty product cask is removed from the vehicle and placed on a cask transfer bogie located in the cask handling tunnel. The bogie transfers the cask to a lid lifting station where the lid is removed, and then to a canister receiving station. The IHLW canister is visually inspected in the canister storage cave and its identification confirmed. After the inspection information is recorded, the canister is lifted by overhead crane and placed into the product cask. The bogie then returns the cask to the lid lifting station where the lid is replaced. The product cask is then transferred to the export station where the cask is lifted by an overhead crane and placed on the transport vehicle. Swab samples are taken, and when the cask exterior is verified to be below the acceptable radioactive contamination level, the cask is transported to a Hanford Site storage facility.

Closed-circuit television cameras will provide general viewing of the canisters and the storage area. Descriptions of inspections of IHLW canister storage areas are included in Chapter 6 of this application. An IHLW canister tracking system will retain required information such as the IHLW identification number, weight, and dimensions of the IHLW canisters.

Instrumentation, alarms, controls, and interlocks will be provided for the HEH to indicate or prevent the following conditions:

- Interlocks to prevent the canister storage cave import hatch and the canister storage cave export hatch from being open at the same time
- Gamma monitoring and keyed interlocks to prevent the cask export hatch from opening when high radiation levels exist
- Interlock to prevent cask handling crane movements into the truck bay unless the truck bay inner roller shutter door is open
- Interlock to prevent the truck bay inner roller shutter door closing if the hoist/cask is in danger zone

- Interlock to prevent cask handling bogie travel to canister storage cave export hatch unless the cask lid is removed and the cask export hatch is closed
- Interlock to prevent the canister storage cave export hatch from being open at the same time as the cask export hatch
- Interlock to prevent hoist lowering cask onto the cask handling bogie unless the cask export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt
- Interlock to prevent hoist lowering canister into cask unless the canister storage cave export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt
- Gamma detectors/interlock to prevent cask handling bogie travel to the cask export hatch unless the cask lid is properly installed
- Interlock to prevent both truck bay "exit" and "entrance" (external) roller shutter doors from being open at the same time
- Interlock to prevent the truck bay inner roller shutter door from being open at the same time as either of the "exit" or "entrance" roller shutter doors

4.1.4.8 HLW Melter Cave Mechanical Systems

Each HLW melter cave mechanical system will consist of the following individual systems:

- HLW melter handling (HMH) system
- HLW melter cave support handling (HSH) system

The individual systems and their primary functions are described below:

HLW Melter Handling (HMH) System

The primary function of the following system is identical for both Melters (HMP-MLTR-00001/2). The HMH system provides the equipment and controls necessary to:

- Transport new melter units into the HLW melter cave in conjunction with the HSH system
- Remove spent melter units from the HLW melter cave
- Decontaminate and monitor the spent melter overpacks

A multi-axle transporter will be used to move a new overpacked HLW Melter to the HLW vitrification plant loading dock. The overpacked melter will be offloaded, transferred through the rollup doors to the melter cave airlock, transferred through the airlock, and docked to the melter cave shield door. After opening the shield and overpack doors, the melter will be moved out of its overpack and installed in the melter cave.

The process of removing a spent HLW Melter from a cave and loading it back into its overpack is the reverse of the installation. The overpack will provide a shielded disposal/storage canister for the spent melter. After the outside surfaces of the overpack have been checked for radiological contamination and decontaminated as required, the spent melter and its overpack will be moved through the melter airlock through the rollup doors and placed on the transporter, to be moved out of the HLW vitrification plant.

Decontamination of the overpack in the C3/C5 airlock, before it is exported, will be performed manually using moist cloths. The HLW Melter overpack's primary function is to serve as a shielded, box-like enclosure for the storage, transport, and disposal of the HLW Melter. The overpack performs a radiological shielding function of the highly radioactive spent HLW Melter. Due to the high radiation levels associated with a spent HLW Melter, the walls on all sides of the HLW Melter overpack will be seal-welded and have a nominal thickness of approximately 8 in. of carbon steel. The estimated weight of the HLW Melter overpack is 250 tons with an empty melter, and 350 tons when carrying a payload of the HLW Melter full of glass. The spent Melter weight when full of glass is a worst case in the event that the residual glass removal described in section 4.1.4.7 cannot be performed. After 3 to 5 years of service, an HLW Melter is expected to reach the end of useful life service, and will be placed in the overpack before removing it from the HLW vitrification plant. The overpack, with the spent HLW Melter inside, will be moved to the HLW failed melter storage facility prior to land disposal. The overpack with spent HLW Melter will be disposed at the Hanford Site if it meets the land disposal facility waste acceptance criteria Regulatory issues and permitting actions associated with onsite disposal of spent and/or failed HLW melters will be addressed in the future.

Justification for on-site burial of the 8 in. carbon steel overpack results from a corrosion study of submarine reactors based on chemical content, resistivity, aeration, and burial methods. The predicted maximum pitting corrosion penetration for a 100-year period was 0.350 in. for reactors buried in geologic conditions similar to those in which the overpacks will be buried. (*Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington, March 1992*).

Prior to disposal, the spent Melter will be stored in the failed melter storage facility. If a Melter fails to meet the receiving TSD waste acceptance criteria, it will be stored until the HLW vitrification plant operating conditions are suitable for the spent melter to be returned to the melter cave for further decontamination, treatment, repackaging, and/or other process to enable the spent melter to meet the receiving facility's waste acceptance criteria.

HLW Melter Cave Support Handling (HSH) System
The primary function of this system is to provide remotely operated equipment to perform these support activities in each melter cave:

- Melter maintenance and replacement
- Melter component and consumable maintenance and replacement
- Melter component and consumable dismantling, sorting, and loading
- Equipment decontamination and hands-on maintenance

Decontamination Tanks (HSH-TK-00001/2) and associated ancillary equipment are included in the HSH system.

Each melter cave will contain an HLW Melter (HMP-MLTR-00001/2), Feed Preparation Vessels (HFP-VSL-00001/5), and HLW Melter Feed Vessels (HFP-VSL-00002/6), and the following offgas system components:

- Film Coolers (HOP-FCLR-00001/2)
- Submerged Bed Scrubbers (HOP-SCB-00001/2)
- High-Efficiency Mist Eliminators (HOP-HEME-00001A/1B/2A/2B)

Overhead cranes, hoists, and master-slave and power manipulators will be the primary equipment used to carry out various replacement, size reduction, and packaging tasks. Auxiliary tools will include impact wrenches, nut-runners, and hydraulic shears.

In addition, the HSH system will provide the means to dismantle and reduce the size of spent melter components or consumables for export out of the cave in waste canisters. Various size reduction tools will be used to cut down the equipment. The waste will be placed on a sorting table for screening and segregation prior to packaging and export.

Prior to Melter replacement, residual glass will normally be removed from a spent Melter. Lid heaters will keep the glass pool at the desired temperature ranges. Air and vacuum lines will be inserted to draw the molten glass into a canister. The spent Melter will then be disconnected and prepared for transport out of the cave.

A consumable bucket, equipped with interchangeable lid cutouts called templates, will be used to import and export melter consumables. The HFP vessels will be organized such that power manipulators can disconnect connections and prepare failed vessels and components for export. Components of the HOP system found in this cave will also be organized for similar activities.

The HSH system will provide a Decontamination Tank (HSH-TK-00001/2) in the equipment decontamination area, to allow for decontamination of consumables and equipment before hands-on maintenance in the crane maintenance area. In the Decontamination Tank, the equipment will be soaked in demineralized water and/or nitric acid. The equipment decontamination area will be used to additionally decontaminate equipment using manipulators before items can be removed for hands-on maintenance. A crane decontamination area is located above the C3/C5 airlock.

HLW Filter Handling (HFH) System

The filter cave is at grade level west of the melter cave 2. The walls, ceiling, and floor of the filter cave are of reinforced concrete. The filter cave contains the spent filter export hatch, which interfaces with the drum transfer tunnel. Gross decontamination of filter cave equipment will be performed in the filter cave. The filter cave also contains a pair of shield doors at the interface between the filter cave and the crane maintenance area. The shield doors provide the barrier between the filter cave and the man-accessed maintenance area. The filter cave is designated as a C5 area.

The C5 filter system in the filter cave will consist of three two-stage HEPA housings (one for melter cave no. 1, another for melter cave no. 2, and one for the canister handling cave and the filter cave itself). In addition, there will be two HEPA filter housings for each melter offgas and PJV systems.

The filter housings will be of stainless steel. The filter lids will be flush with a stainless steel clad false floor (filter cave deck) that covers the entire cave at 14 ft elevation. The following equipment will be used for replacement of HEPA Filters and with other in-cave activities.

- Power manipulators
- Crane and cable reeling system
- Spent filter export hatch

~~HLW melter cave mechanical systems will consist of the following individual systems:~~

- ~~HLW Melter Cave Support Handling (HSH) System~~
- ~~HLW Filter Handling (HFH)~~
- ~~HLW Melter Handling (HMH) System~~

- ~~Radioactive Solid Waste Handling (RWH) System~~

~~The individual systems and their primary functions are described below:~~

~~HLW Melter Cave Support Handling (HSH) System~~
~~The primary function of this system is to provide remotely operated equipment to perform these support activities in the melter cave:~~

- ~~Melter maintenance and replacement~~
- ~~Melter component and consumable maintenance and replacement~~
- ~~Melter component and consumable dismantling, sorting and loading~~
- ~~Equipment decontamination and hands-on maintenance~~

~~The melter cave will contain the melter, melter feed preparation and feed vessels, and certain offgas system components. Overhead cranes, hoists, master-slave and power manipulators will be the primary equipment used to carry out various replacement, size reduction, and packaging tasks. Auxiliary tools will include impact wrenches, nut-runners, and hydraulic shears.~~

~~In addition, the HSH will provide the means to dismantle and reduce the size of spent melter components or consumables for export out of the cave in waste containers. Various size reduction tools will be used to cut down the equipment. The waste will be placed on a sorting table for screening and segregation prior to packaging and export.~~

~~Melter replacement will generally be preceded by an alternate glass removal step. Lid heaters will keep the glass pool at the desired temperature ranges. Air and vacuum lines will be inserted to draw the molten glass into an attached canister. The failed melter will be disconnected and prepared for transport out of the cave.~~

~~A consumable bucket, equipped with interchangeable lid cutouts called templates, will be used to import and export melter consumables. HLW Melter Feed Process System vessels will be organized such that power manipulators can disconnect connections and prepare failed vessels and components for export. Components of the HOP found in this cave will also be organized for similar activities.~~

~~The HSH will provide a crane decontamination room above the C3/C5 airlock, to allow for decontamination of equipment before hands-on maintenance in the crane maintenance area. In the decontamination room, the crane and equipment will be decontaminated with a demineralized high pressure wash water spray. Non-organic detergents or acid solvents may also be used, if needed. Wash water will be collected by a sump.~~

4.1.4.9 Radioactive Solid Waste Handling (RWH) System

The following system supports both HLW Melters (HMP-MLTR-00001/2) and the HLW filter cave. The primary functions are to:

- Provide canisters for removal of miscellaneous solid waste from the HLW melter cave and filter cave
- Transport filled and empty waste canisters
- Provide external radiological monitoring of waste canisters
- Decontaminate waste canisters as required
- Supply and load waste canisters into transport casks

The RWH system consists of three major operational areas: the drum transfer tunnel, the swabbing and monitoring area, and the cask handling area. Mixed waste is generated in melter caves 1 and 2, the canister handling cave, and the filter cave. Mixed waste generated in the canister handling cave is transferred to either melter cave via the pour tunnels and then exported from the melter caves to the drum transfer tunnel. The drum transfer tunnel runs beneath these areas and provides a common area for receipt of waste to consolidate the separate waste streams into a single export path. The RWH system receives waste from the HSH system (melter caves 1 and 2) and the HFH system (filter cave) contained in lidded waste baskets that are lowered through the transfer ports in the ceiling of the drum transfer tunnel.

The RWH system introduces empty 55-gallon drums into the HLW plant for packaging radioactive solid waste for disposal. Empty 55-gallon drums are placed into shielded casks in the canister export truck bay. The cask is transferred on the cask transport vehicle into the cask import/export area for ultimate transfer from the plant.

The cask is positioned under the monorail hoist. It is then lifted, transferred to, and positioned onto the cask transfer bogie. A shield door is opened and the bogie is moved to the cask lidding station. The cask lid pintle is aligned with the lifting claw of the cask lidding machine and the cask lid is removed. The cask is then positioned under the cask transfer hatch. The drum, lid, and clamping ring are imported into the swabbing and monitoring area and manually staged on a stand in front of the shield window.

The drum transfer bogie rolls to position beneath a transfer hatch of either melter cave no. 1, melter cave no. 2, or the filter cave. With the drum positioned under the selected cave transfer port, a loaded waste basket is lowered into the drum by the interfacing cave system's crane and grapple. With the basket located in the drum, the grapple is detached and raised by the system crane. The full 55-gallon drum is relocated back to the position under the drum transfer hatch to the swab and monitoring area. The drum is lifted into the swab and monitoring area using the overhead crane and drum grapple.

The RWH system transports loaded drums into the lidding, swabbing, and monitoring area for lidding, swabbing, external monitoring, and decontamination (if required). The system then exports the filled 55-gallon drums through the import/export area.

The following operations are performed:

- The crane lifts the drum to the swabbing and monitoring station. Two master-slave manipulators will be mounted on the wall of the swabbing and monitoring area and will provide the operator interface for installation of the drum outer lid and clamping ring while the drum is positioned on the drum turntable.
- The robotic swabbing arm and turntable swab the surface of the drum. The swabs are placed in the shielded posting of the swab analyzing station. Following preliminary measurement of the swab, the posting port is actuated to move the swab into the swabbing and monitoring glovebox where the sample is analyzed and bagged out for disposal.
- If the swabs are within acceptable limits, the crane lifts the drum from the drum swabbing turntable and positions the drum over the cask transfer hatch and places it in the shielded cask on the cask transport bogie.
- If the drum requires decontamination, additional swabbing of the drum will be performed to remove the contamination. Remote-handled decontamination equipment is available in the cave to be used if additional swabbing is insufficient to meet disposal requirements.
- The cask transfer bogie moves to the cask lidding station where the cask lid is replaced onto the cask. The bogie then moves to a gamma monitor where radiation levels are verified before the import/export shield door is opened and the cask transfer bogie moves into the import/export area. Once the cask is in the import/export area and the import/export shield door is closed, operators enter to bolt the lid onto the cask. The monorail then moves the cask to the cask handling truck. The cask handling truck positions the cask under the truck bay crane. From the cask import/export area, the crane positions the cask on a vehicle for transfer from the plant.

~~The primary functions of this system are to:~~

- ~~Provide containers for removal of miscellaneous solid waste from the HLW melter cave and filter cave~~
- ~~Transport filled and empty waste containers~~
- ~~Provide external radiological monitoring of waste containers~~
- ~~Decontaminate waste containers as required~~
- ~~Assay waste containers to determine radiological inventory~~
- ~~Supply and load waste containers into transport casks~~

- Transfer casks to the central waste storage facility

At both the filter cave and the melter cave, the drum will be positioned under the filter cave/melter cave export well and the drum transfer bogie will be locked into position. The containment between the filter cave/melter cave, and the drum transfer tunnel will be maintained by an engineered air-gap between the top of the drum and the underside of the export well. A loaded basket will then be lowered into the drum, using the filter cave/ melter cave handling equipment. The drum will then be lowered and transferred to the drum lidding station, where the outer lid will be replaced and crimped onto the drum.

One of the main functions of the RWH is to transport waste containers between the plant operating area and the swabbing and monitoring area within the RWH. Prior to transporting to the central waste storage area, the sealed drums will be swabbed for contamination along their bottom, sides, and lid interface. Viewing windows will be positioned to allow for the evaluation of the swabbing process. The swabs will be monitored for radiological contamination in an external glovebox. If surface contamination exceeds the accepted limits, the drum will be repeatedly vacuum-cleaned, swabbed, and washed with wet swabs until the radiological limits have been met. Drums will be transported by means of an overhead bridge crane and drum grapple. The drums will be lowered through the swabbing and monitoring system floor hatch into an open transport cask. The cask lid will be replaced and the cask will be monitored for gamma radiation shine paths before it is transferred to the import/export area by means of the cask transfer bogie. The cask will then be transferred to the truck bay by an overhead crane for shipment to the central waste storage area.

4.1.4.10 HLW Vitrification Plant Ventilation

The HLW vitrification plant will be divided into four numbered zones listed and defined below, with the higher number indicating greater radiological hazard potential and, therefore, a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and, hence, the amount of air requiring treatment. Adherence to this concept in the design and operation of the HLW vitrification plant will ensure that the plant air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An exhaust air radiation monitoring system, consisting of sensors to monitor radiation in the exhaust air stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor, and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation (C1V) System
C1 areas will typically consist of offices, workshops, control rooms, and equipment rooms. They will be slightly pressurized if they are adjacent to areas with higher contamination potential to eliminate backflow from those areas.

C2 Ventilation (C2V) System
C2 areas will typically consist of operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated exhaust fans. Air supplied to the C2 areas that is not cascaded to the C3 or C5 areas is discharged to the atmosphere by the exhaust fans. Both exhaust fans are provided with variable frequency drives. A manual isolation damper is provided upstream of each exhaust fan, and a pneumatically actuated isolation damper is provided downstream. Each damper is provided with local/remote position monitoring.

C3 Ventilation (C3V) System
C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used.

C5 Ventilation (C5V) System
Where there is in-bleed air from the C3 to C5 system, fan cascade trip interlocks protect the system from backflow.

The C5 areas in the HLW vitrification plant will be composed of the following:

- Pour caves
- Transfer tunnel
- Buffer storage area
- Process cells

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered duct entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow filter isolation dampers, with penetrations through the boundary sealed.

The HLW vitrification plant will be divided into four numbered zones listed and defined below, with the higher number indicating greater radiological hazard potential and, therefore, a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence, the amount of air requiring treatment. Adherence to this concept in the design and operation of the HLW vitrification plant will ensure that the plant air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An effluent radiation monitoring system, consisting of sensors to monitor radiation in the effluent stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor, and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation System (C1V)
C1 areas will typically consist of offices, workshops, control rooms, and equipment rooms. They will be slightly pressurized if they are adjacent to areas with higher contamination potential, to eliminate backflow from those areas.

C2 Ventilation System (C2V)
C2 areas will typically consist of operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated exhaust fans. Air supplied to the C2 areas which is not cascaded to the C3 or C5 areas is discharged to the atmosphere by the exhaust fans. Both exhaust fans are provided with variable frequency drives. A manual isolation damper is provided upstream of each exhaust fan and a pneumatically actuated isolation damper is provided downstream. Each damper is provided with local/remote position monitoring.

~~C3 Ventilation System (C3V)~~
~~C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used.~~

~~C5 Ventilation System (C5V)~~
~~In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed.~~

~~The C5 areas in the HLW vitrification plant will be comprised of the following:~~

- ~~Pour caves~~
- ~~Transfer tunnel~~
- ~~Buffer storage area~~
- ~~C3/C5 drain tank room~~
- ~~Process cells~~

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered duct entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow HEPA filter isolation dampers, with penetrations through the boundary sealed.

4.1.5 Analytical Laboratory

The analytical laboratory ~~designed to incorporate the features and capability necessary to ensure efficient WTP operations and meet permitting, process control, authorization basis, and waste form qualification requirements. The design will be validated with information from tank utilization modeling of the process tankage and operational research modeling of the treatment process, as appropriate. Figure 4A-107 in DWP Attachment 51 provides a general layout of the first floor of the WTP analytical laboratory where analytical, maintenance, administrative, and waste management activities take place. The following attributes are outlined in the facility design figures described above:~~ <u>will be designed to incorporate the features and capability necessary to ensure efficient WTP operations and meet permitting, process control, authorization basis, and waste form qualification requirements. The design will be validated with information from tank utilization modeling of the process tankage and operational research modeling of the treatment process, as appropriate. Figure 4A-107 in DWP</u>

Attachment 51 provides a general layout of the first floor of the WTP analytical laboratory where analytical, maintenance, administrative, and waste management activities take place. The following attributes are outlined in the facility design figures described above:

- Workstations have been defined as required by the sampling and analysis plan for WTP process control and waste form qualification
- Capability to provide ~~the~~ limited process technology ~~is~~ will be provided ~~in both the hot cell area and the radiological laboratory rooms for specialized sample evaluations~~
- ~~Redundancy of major instrumentation has been accommodated~~
- Contamination controls has~~ve~~ been incorporated for reliability of laboratory service to the WTP processes
- ~~Receipt and processing~~Management of DST system samples ~~are accommodated in both capability and capacity~~ for receipt and analysis by an outsource laboratory
- ~~An administrative area has been provided to support a fully operational, stand-alone facility~~

~~Figure 4A-108 provides a layout of the second floor. The second floor of the analytical laboratory provides for analyses and segregation of the radioactive samples from the low and non-radioactive samples. Reliability is assured that contamination of the low-active samples will not be problematic. There are no entrances directly between the main floor and the second floor without egress through the change rooms. Samples are introduced through an outside door directly to the second floor. Prepared sample aliquots for radionuclide quantitation are transferred by dumbwaiter directly to the appropriate counting room.~~

~~Room is available to process essential materials and prepare reagents for laboratory performance monitoring using standards and laboratory reagents. The second floor also provides ample office space for the professional staff, including a conference room and training room space, data package assembly and oversight, and support staff for the laboratory information management system.~~

~~The hot cell area includes a row of hot cells that support WTP Process Technology as shown in Figure 4A-109. Two below-grade counting rooms are shown in Figure 4A-110 near the below-grade tank system. The counting rooms are located below grade to make use of the shielding from the earth surrounding the room to reduce the background in the rooms as much as possible. One counting room is dedicated to the effluent level, radionuclide quantitation, and the second is dedicated to high radionuclide concentration samples. Dumbwaiters deliver the prepared sample aliquots from the high activity laboratories to the high activity counting room, and the prepared mounts from effluent samples to the low activity counting room. Radionuclide detection levels necessary to manifest the retention basin water for disposal at treated the LERF/ETF can be met in this facility. Most instrumentation is duplicated in each counting room; however, certain specialized instrumentation is provided uniquely where applicable.~~

~~The wall separating the two counting rooms provides shielding from the gamma emissions from high-activity samples entered into the high activity room. Wastes generated in the analytical laboratory will be recycled through the pretreatment process or packaged and transferred to the central waste storage facility awaiting disposal.~~

~~The following figures found in Appendix 4A provide additional detail for the analytical laboratory:~~

- ~~Simplified process flow figure for process information~~
- ~~Typical system figure depicting common features for the regulated tank system~~
- ~~Simplified general arrangement figures showing locations of equipment and tanks~~
- ~~Contamination/radiation area boundary figures showing contamination/radiation zones throughout the lab~~

~~Descriptions of the analytical laboratory process and mechanical handling systems are provided in the following sections.~~

Figures 4A-108 through 4A-117 found in DWP Attachment 51 provide additional detail for the analytical laboratory:

- General arrangement figures showing locations of analytical laboratory activities
- Process flow figures for process information
- Typical system figures depicting the analytical laboratory tank systems
- Figures depicting the ventilation system

The WTP analytical laboratory will contain high-activity and low-activity laboratories. High-activity samples will be managed in the analytical hotcell laboratory equipment (AHL) system. Low-activity samples will be managed and analyzed in the analytical radiological laboratory equipment (ARL) system also known as the rad labs. The ARL system also includes a sample management area designed to manage the inflow of manually transported samples. Most samples sent to offsite laboratories will be low-activity and environmental samples. Analytical methods and equipment selected to support laboratory analyses will be in accordance with applicable requirements.

The second floor of the analytical laboratory will be dedicated to the mechanical room, which contains the C1 and C2 air handling units. The Radioactive Liquid Waste Disposal (RLD) System vessels will be located at approximately 19 ft below grade.

The facility will also be designed to coordinate the management of samples that will be outsourced and analyzed at offsite laboratories. Outsource laboratories will be used to analyze the majority of very low-activity samples such as water quality and air emission samples. Outsource laboratories may also be used to analyze DST system unit characterization samples.

Samples will be transported to the analytical laboratory in two ways. The majority of samples will be collected and transported from the processing facilities via the autosampling (ASX) system. Samples will be collected in a sample bottle or vial and transferred into a sample carrier. High-activity samples from the pretreatment and HLW vitrification plants will be pneumatically transferred to the hotcell sample receipt area through a dedicated transfer system for high-activity samples. Low-activity samples from the LAW vitrification plant and nonradioactive samples from the balance of facilities will be transferred directly to the sample receipt laboratory area through a dedicated low-activity transfer system. A small percentage of samples will be transported to the laboratory manually in appropriately shielded transportation casks or containers.

Regulated analytical laboratory tank system process and leak detection system instruments and parameters will be provided in DWP Table III.10.E.H.

4.1.5.1 Analytical Radiological Laboratory Equipment System

The rad labs are being designed to support the preparation and analysis of low-to-moderately mixed waste samples. The rad labs also support the analyses of high-activity mixed waste plant samples collected, diluted, and processed in the hotcell facility. Samples will be manually transferred from the hotcell facility to the rad labs. The rad labs will be capable of receiving low-to-moderate activity samples transferred from the process facilities via the ASX system as well as manually transported low-to-moderate activity samples from the process facilities and other DOE facilities.

The rad labs include the facilities and equipment required to support activities such as:

- Sample receipt and (manual) transport
- Dissolution/dilution
- Distillation/titration
- Standard/reagent preparation
- X-ray fluorescence spectrometry and x-ray diffraction analysis
- Fourier transformation infrared spectrometry (FT-IR)
- Total inorganic analyses
- Quantitation of metals and anions
- Ultraviolet and visible spectroscopy
- Preparation of glass samples for elemental analysis
- General physical properties analysis

- Radionuclide separation and counting
- Management of outsourced samples

4.1.5.2 Analytical Hotcell Laboratory Equipment (AHL) System

The analytical hotcell laboratory equipment system will be designed to provide sample preparation and analysis of high-activity samples collected at the WTP and other DOE facilities. The hot cells will be capable of accepting samples from each of the production facilities using pneumatic transport or transported manually. The samples will be transported to the hot cells or to the rad labs either directly, after dilution, or after stripping off the radioactive content.

The analytical hotcell laboratories will include facilities and equipment necessary to perform activities such as:

- Sample receipt and transport to other hot cells and the rad labs
- General physical properties analysis
- Dilution, fusion, and acid digestion required to prepare samples for subsequent analysis
- Waste management activities

4.1.5.3 Autosampling (ASX) System

~~The sampling will be performed by a computer-controlled autosampler system. A clean sample vial is pneumatically transferred to the autosampler unit, where the vial is mounted on a sample needle through the vial septum. The other end of the sample needle penetrates a sample loop that is circulated by a reverse flow diverter. A venturi effect on the sample needle creates a slight negative pressure in the sample vial, as the diverter circulates the waste through the sample loop. When the flow in the sample loop slows to a stop, the venturi effect ceases and waste is drawn into the sample vial. The vial is withdrawn from the needle after the appropriate sample volume is collected, placed in a carrier and pneumatically transferred to a shielded sampling cabinet in the laboratory for sample preparation and analysis.~~
Samples will be collected into a sample bottle or vial and then transferred into a sample carrier. Sample carriers are then pneumatically transferred to either the laboratory hot cell or radiological laboratory depending on where the sample was collected. The ASX system consists of high-activity and low-activity sampling systems. The high-activity sampling system collects and pneumatically transfers samples from the PTF and HLW plants to the receipt cell within the hot cell laboratory. Low-activity samples collected from low-activity waste streams are pneumatically transferred directly to the radiological laboratory.

~~High Activity Laboratory~~

The high activity laboratory will consist of a main sample receipt area and several hot cells. Descriptions of these areas are summarized below:

High Activity Laboratory Receipt Facility
The high activity laboratory receipt facility will remove the sample bottle from the sample carrier and moves it into the high activity laboratory hot cells. The laboratory receipt facility will be equipped with a gamma monitor to detect residual radiation.

Hot Cells
The high activity samples will be handled in hot cells. The hot cells will include equipment and facilities to perform activities such as the following:

- Sample receipt
- Total Organic analysis
- Glass sample preparation
- Toxicity Characteristic Leaching Procedure (TCLP) analysis
- Gamma analysis
- General physical properties analysis

Low Activity Laboratory
The low activity samples will be handled in the low activity laboratories. The main activities that will be performed in these laboratories are listed below:

- Sample dispensing
- X-ray spectrometry (XRF) and X-ray diffraction (XRD) analysis
- Total organic analysis
- General chemistry analysis with differential scanning calorimeter, cold vapor atomic absorption, cyanide analysis, ion chromatograph
- Atomic Emission Spectroscopy (AES)
- Gamma and alpha analysis

~~Sampling Methods~~

~~Methods and equipment selected for use will meet the applicable requirements of the specific SW-846 or other appropriate sampling or analysis procedures. Modifications of a procedure, other than sample size, will be requested in accordance with applicable requirements.~~

~~Cascade Ventilation System for Analytical Laboratory Hot Cells~~

~~A primary factor in the design of the ventilation system for the WTP is the need to isolate the sources of radiation, and radiological and dangerous waste contamination, to protect human health and the environment during normal and abnormal operating conditions. Barriers or barrier systems, including ventilation systems, will contain and minimize the release of radionuclides and contaminants. The ventilation systems are designed to conform to stringent nuclear facility ventilation standards, and fugitive emissions from the pretreatment and vitrification facilities will be minimized.~~

~~The pretreatment plant, LAW vitrification plant, HLW vitrification plant, and analytical laboratory will be divided into five numbered zones, with the higher number indicating greater contamination potential and, therefore, a requirement for a greater degree of control or restriction. A separate zoning system for the ventilation systems will be based on the system for classifying building areas for potential contamination. Zones classified as C5 will have the potential for the greatest contamination and will include the pretreatment cells, melter cells, and glass pouring and cooling cells. C5 zones will be operated remotely. Zones classified as C1 will be those areas that have no risk of contamination, such as equipment rooms and offices. Confinement will be achieved by maintaining the greatest negative pressure for areas with greatest contamination (e.g., C5 areas), with airflows cascade from least to most contaminated areas (e.g., C1 or C2 to C5 areas). The principle of a cascade system, in which air passes through more than one area, effectively reduces the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this principle in the design and operation of the WTP will ensure that the plant will not become a significant source of radiological or dangerous waste exposure to operators, or emissions to the environment.~~

4.1.5.4 Solid Waste Management

Solid mixed and dangerous waste will be accumulated in the hot cells and periodically placed in waste drums. Waste from the individual hot cells will be transferred to a waste management cell where waste management, consolidation, and packaging activities are conducted. The waste cell contains tools and equipment to complete size reduction. These solid mixed and dangerous wastes as well as organic lab pack wastes will be transferred into waste drums prior to being transferred to the laboratory waste drum management area. Ventilation flow from the hot cell area, including the waste cell, will be routed to the C5 HEPA filtration system.

Solid mixed and dangerous waste and organic lab pack wastes from the rad labs and maintenance areas will be accumulated in the individual labs and shops until they are transferred to the laboratory waste management area for waste consolidation and volume reduction. Waste consolidation will be completed in the volume reduction and lab pack rooms in the waste drum management area.

Waste drums will be transferred to a permitted TSD site or low level radioactive waste facility. Lab pack drums or waste drums containing liquid mixed or dangerous wastes will be managed on spill pallets. The management area will be coated with a special protective coating and the area will be ventilated to the C2 ventilation system. Floor drains from the waste management area will flow into the Laboratory Floor Drains Collection Vessel (RLD-VSL-00163).

4.1.5.5 Radioactive Dangerous Liquid Waste Disposal (RLD) System

The analytical laboratory RLD system is primarily composed of the following:

- Floor Drain Collection Vessel (RLD-VSL-00163)
- Laboratory Area Sink Collection Vessel (RLD-VSL-00164)
- Hotcell Drain Collection Vessel (RLD-VSL-00165)
- Associated ancillary equipment

The Floor Drain Collection Vessel (RLD-VSL-00163) collects, contains, and transfers noncontaminated liquid effluent. Although the floor drain collection vessel is identified as part of the RLD system, it is not designed or permitted to manage mixed or dangerous wastes. If a spill or release were to occur that contaminated this vessel, the vessel would be discharged to the Laboratory Area Sink Collection Vessel (RLD-VSL-00164) or the Hotcell Drain Collection Vessel (RLD-VSL-00165) and rinsed with water prior to being returned to service. This vessel collects effluent from radiological laboratory floor drains, eyewash, and safety shower equipment. The vessel also collects effluent from the C2 area floor drains located in areas such as the laboratory area corridors, hotcell bay area, and the filter room.

4.1.5.6 Laboratory Maintenance

The analytical laboratory maintenance shop provides space for performing preventive and corrective maintenance on laboratory equipment. There will be two shops, located in different potential contamination areas. The C3 shop allows decontamination, maintenance, and storage of contaminated equipment such as hotcell manipulators. The C3 maintenance shop will be ventilated to the C3 ventilation system, and effluent from the C3 maintenance shop discharges to the Laboratory Area Sink Collection Vessel (RLD-VSL-00164). The C2 shop will provide space for the maintenance of equipment that is not expected to be radioactively contaminated such as electrical components, utilities systems components, and instruments, and will be ventilated to the C2 ventilation system. A list of proposed maintenance activities that will be performed in the analytical laboratory maintenance shops is provided below.

Analytical Laboratory Maintenance and Waste Management Activity Summary

Task Description	Lab C3 Shop	In Situ Activities
Filter change out [a]		X
Manipulator repair [b]	X	X
Valve maintenance	X	X
Pump maintenance	X	X
Exhaust fan maintenance	X	X
Repair and fabricated equipment	X	X
Instrument calibration	X	X

a Spent filters will be disposed of following filter change out using approved maintenance, waste management, and radiological procedures.

b Manipulators requiring extensive repairs will be pulled and transferred to the C3 workshop for decontamination. Once the contamination levels are reduced to within acceptable limits for hands-on maintenance, the manipulator will be repaired using approved maintenance and radiological procedures.

4.1.5.7 Laboratory Ventilation Systems

The analytical laboratory ventilation systems include C1V, C2V, C3V, and C5V systems that aid in the containment and confinement of mixed and dangerous constituent hazards. Clean occupied areas without contamination potential are classified as C1 and will be isolated from normally clean occupied areas with the potential for contamination (C2) and from areas with restricted occupancy, normal radiological hazards and higher contamination potential (C3 and C5).

C3 areas are restricted occupied areas and allow operator access under administrative controls as required for scheduled maintenance and operations. C5 areas have the highest contamination potential and will normally be unoccupied. These areas have, by virtue of their location and the activities performed within them, an increased potential for the release of contamination. The analytical laboratory C5 ventilation system will be an integral part of the complete analytical laboratory HVAC system. The design objectives of the analytical laboratory HVAC system, and therefore the C5 area ventilation system, will be as follows:

- Aid in the confinement and containment of mixed and dangerous constituent contamination sources
- Remove airborne particulates from the discharge air to ensure that emissions are within prescribed limits
- Maintain space temperatures within the indoor design conditions
- Satisfy safety requirements and codes and standards that are a part of the Safety Requirements Document

The C5 area ventilation system is being designed to maintain a negative pressure in the C5 areas with respect to the surrounding areas. Hotcell ventilation, the Hotcell Drain Collection Vessel (RLD-VSL-00165), and the C3 maintenance shop glovebox will be exhausted to the C5 ventilation system. Fume hoods within the rad labs, the waste reduction and lab pack room, and the C3 maintenance shop will be exhausted to the C3 ventilation system. The ventilation from C2, and C3 areas will be filtered through a single stage of HEPA filters and exhausted through the analytical laboratory stacks. Air cascading into the C5 areas from the adjacent C2 and/or C3 areas will be exhausted through the analytical laboratory building stack by the C5 exhaust fans after passing through two stages of HEPA Filter banks.

4.1.6 Balance of Facilities (BOF)

The balance of facilities will ~~include~~ provide support systems and utilities required for the waste treatment processes within the pretreatment plant, LAW vitrification plant, HLW vitrification plant, and analytical laboratory. ~~Specific operational facilities will be established to provide the BOF support systems and utilities~~. These will include, but will not be limited to, heating and cooling, process steam, process ventilation, chilled water, primary and secondary power supplies, and compressed air. ~~Local control panels will be provided in each building, with the main control room located at the pretreatment plant.~~

~~Unlike the waste treatment process areas, the BOF support systems and utilities will not manage dangerous waste, therefore this section is provided for information purposes only~~.

4.1.6.1 ~~Instrument Service Air (ISA) and~~ Plant Service Air (PSA) Systems

The process plant service air system will provide a continuous supply of compressed air for the process tanks and vessels in the pretreatment plant, analytical laboratory, LAW vitrification plant, ~~and~~ HLW vitrification plants, and other miscellaneous uses. ~~The instrument air system will receive air from the process air system, and further dry the air through dessicant dryers. Process air and instrument air that have entered the process plants will not return to the BOF~~.

Critical users (those who would be compromised or damaged by loss of process air) will include the following systems, components, or controls:

- Instrument air system
- The ultrafiltration system
- Melter support systems

The compressors will be located in the chiller/compressor building.

4.1.6.2 Plant Cooling Water System (PCW) ~~System~~

The cooling water system will supply cool water to heat exchangers supporting process equipment coolers. Cooling water will remove heat from plant equipment coolers in the process buildings and return the heated water to a multi-cell mechanical draft-cooling tower where the heat will be released. The cooling water system is designed to remain uncontaminated by ~~chemical and radiological~~ mixed waste constituents. The cooling water will be chemically treated ~~and filtered~~ to promote system operability and extend service life to 40 years.

4.1.6.3 Low-Pressure Steam System (LPS) ~~System~~

~~The low-pressure steam system operates at approximately 85 psig at 330 °F~~. This system will provide a continuous supply of low-pressure steam for various users in the pretreatment plant, LAW vitrification plant, and HLW vitrification plants. The process plants' main use of steam will be for tank heating~~, and~~ for the evaporation process, and for HVAC heating coils.

The low-pressure steam system will be supplied from the high-pressure steam system through pressure-reducing stations. The steam condensate and feed system will collect condensate from the low-pressure steam users, monitor for ~~radioacivity~~mixed waste contamination, and return it to the steam plant for re-use.

4.1.6.4 High-Pressure Steam System (HPS) ~~System~~

The system will provide a continuous supply of high-pressure ~~(approximately 135 psig at 360 °F)~~ steam for the ejectors in the pretreatment plant, LAW vitrification plant, and HLW vitrification plants~~. Once the steam enters the process building it will not return to the BOF~~.

The steam plant will house the boilers that produce the steam.

4.1.6.5 Demineralized Water System (DIW) ~~System~~

This system will distribute demineralized water to various plant locations, after drawing it off the process water system (described below). ~~Once the demineralized water enters the process buildings it will not return to the BOF~~

The system can deliver demineralized water for the following processes:

- Fresh ion exchange resin addition
- Wash rings
- Decontamination
- Melters
- Analytical laboratory

4.1.6.6 Process Service Water System (PSW) ~~System~~

This system will supply ~~raw~~ filtered water to end users. This water will serve processes such as offgas treatment, plant wash systems, and make-up to chilled water systems.~~and process reagent systems. Once the process water enters the process buildings it will not return to the BOF.~~

4.1.6.7 Chilled Water (CHW) System

This closed-loop system will supply chilled water to various HVAC unit cooling coils and plant equipment coolers for the WTP. ~~The system is a closed loop and will provide approximately 65 psi at the junction with process buildings.~~ Chilled water will be used in various systems throughout the WTP. The chilled water system is designed to remain uncontaminated by ~~chemical and radiological~~ mixed waste constituents. The chilled water will be chemically treated to promote system operability and extend the service life to 40 years.

4.1.6.8 Glass Former Reagent (GFR) System

The glass former reagent system provides glass former reagents and sucrose to the LAW and HLW vitrification facilities.

4.2 WASTE MANAGEMENT UNITS

The following sections provide information on the waste management units at the WTP:

- Containers, including management and storage areas - Section 4.2.1
- Tanks systems for storage and treatment - Section 4.2.2
- Miscellaneous units - Section 4.2.3
- Containment buildings - Section 4.2.4

4.2.1 Containers [D-1]

This section of the ~~application~~permit identifies the containers and container management practices that will be followed at the WTP. The term "container" is used as defined in Washington Administrative Code (WAC) 173-303-040. Note that in the ~~DWPA~~permit, terms other than containers may be used, such as canisters, boxes, bins, flasks, casks, and overpacks.

~~The container storage areas located in the LAW vitrification plant are:~~

- ~~ILAW buffer container storage area (immobilized glass)~~
- ~~ILAW container storage area (immobilized glass)~~
- ~~ILAW container storage area (secondary waste)~~

The container storage areas located in the HLW vitrification plant consists of:

- IHLW ~~container~~ canister storage ~~area~~cave (immobilized glass) (H-0132)
- HLW ~~container storage area 1E~~east corridor El. 0 ft (secondary waste) (HC-0108/09/10)
- HLW ~~container storage~~loading area ~~2~~(secondary waste) (H-0130)
- ~~HLW container storage area 3 (secondary waste)~~

The container storage areas (secondary waste) located within the analytical laboratory consists of:

- Waste Drum Management Room (A-0139)
- Lab Pack Room (A-0139A)
- Airlock (A-0139B)
- Volume Reduction Room (A-0139C)
- Airlock/Clean Drum Export Room (A-0139D)

The container storage areas (secondary waste) located within the ~~BOF~~balance of facilities consists of:

- ~~Central waste storage facility~~
- Nonradioactive dangerous waste storage area
- ~~LAW out of service~~Failed melter storage facility
- ~~HLW out of service melter storage facility~~

Container storage area dimensions at the WTP are summarized in Table 4-2.

The following sections address waste management containers:

- Description of Containers - section 4.2.1.1
- Container Management Practices - section 4.2.1.2
- Container Labeling - section 4.2.1.3
- Containment Requirements for Storing Waste - section 4.2.1.4
- Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers - section 4.2.1.5

4.2.1.1 Description of Containers [D-1a]

Four types of waste will be managed in containers:

- IHLW (immobilized glass)
- ILAW (immobilized glass)
- Miscellaneous mixed waste (secondary waste)
- Miscellaneous nonradioactive dangerous waste (secondary waste)

The waste form dictates the type of containers used for waste management. The following paragraphs describe these four types of ~~containers~~containerized waste ~~which~~that are managed by the WTP.

Immobilized Glass Waste

The immobilized glass waste is a mixed waste that will be managed in ILAW containers and IHLW canisters specially designed to remain stable during receipt of glass waste, and which are capable of remote handling. ~~Schematics of the example IHLW containers and ILAW containers are presented in Figures 4A-118 and 4A-119.~~ The Permittees are developing a petition to delist IHLW.

The ILAW ~~immobilized glass waste~~containers will be approximately 90 ~~inches~~ in. high and 48 ~~inches~~in. in diameter, with a wall thickness of approximately 0.187 ~~inches~~ in. and a nominal capacity of 90 ~~cubic feet~~ ft^3. ILAW containers will be constructed of austenitic (304) stainless steel.

The IHLW canisters will be approximately 177 ~~inches~~in high and 24 ~~inches~~in. in diameter, with a wall thickness of approximately 0.1345 ~~inches~~in. and a nominal capacity of 43 ~~cubic feet~~ ft^3. The IHLW canisters will be constructed of austenitic (304L) stainless steel.

Based on results from the programs at the Oak Ridge National Laboratory and Savannah River Technology Center, the 304L stainless steel is physically and chemically compatible with the IHLW glass waste.

Miscellaneous Mixed Waste

Generally, miscellaneous mixed wastes are secondary wastes that may include, but are not limited to, the following items:

- Spent or failed equipment
- Spent, dewatered ion exchange resins in the pretreatment plant
- Offgas HEPA filters
- Melter consumables
- Analytical laboratory waste
- ~~Out of service~~Spent melters

Spent equipment and offgas filters will typically be managed in commercially-available containers such as steel drums or steel boxes, of varying size. The containers for miscellaneous mixed waste will comply with transportation requirements, with receiving TSD waste acceptance criteria, and will be compatible with the miscellaneous mixed waste. These containers may or may not include a liner. Final container selection, container and waste compatibility, and the need for liners, will be based on the physical, chemical, and radiological properties of the waste being managed.

Spent ion exchange resins will be dewatered and managed in containers ~~that will be approximately 100 in. high by 88 in. on a side~~. This waste will be generated and managed in the pretreatment plant, until it is~~moved to the central waste storage area or shipped to a Hanford Site~~

transferred to a suitable TSD unit for further management. The containers for this miscellaneous mixed waste will comply with receiving TSD waste acceptance criteria.

Melter consumables are routinely generated wastes and include spent feed tubes, pressure transducers, bubblers, and discharge risers. LAW melter consumables will be placed into approved disposal containers of varying size. HLW melter consumables will be placed into commercially available steel containersremotely size reduced and placed into steel baskets with lids. The baskets will be placed into drums and the drums placed into shielded casks for export from the facility.

The LAW locallyLocally sShielded melterMelter (LSM) is a Resource Conservation and Recovery Act (RCRA)(RCRA 1976) miscellaneous unit within a welded container or overpack. The radiological shielding containing the melter will serve as the melter's final disposal container. When the locally shielded melter has reached the end of its operational life, it will be disconnected from systems. The overpack will then be prepared for disposal. will be classified as hazardous debris for land disposal restrictions purposes. After a spent HLW melterMelter is deemed to be wastemeet criteria and regulations for onsite disposal, it will be removed from service and placed in a welded carbon steel container (overpack) approximately 21 x 18 x 16 ft. highor other acceptable packaging in accordance with waste acceptance criteria for the receiving TSD. Regulatory issues and permitting actions associated with onsite disposal of spent and/or failed melters will be addressed in the future.

Each miscellaneous mixed waste container will have associated documentation that describes the contents, such as waste type, physical and chemical characterization, and radiological characterization. This information will be retained within the plant information network.

Most miscellaneous secondary mixed wastes will be spent equipment and consumables such as pumps, air lances, HEPA filters, etc., and are not expected to contain liquids. If wastes are generated that contain liquids, these wastes may be treated to remove or absorb liquids, to comply with the receiving TSD waste acceptance criteria. In addition, the analytical laboratory will generate containerized liquid waste (lab packs).

Miscellaneous Nonradioactive Dangerous Waste

Each nonradioactive dangerous waste container will have associated documentation that describes the contents, such as waste type and physical and chemical characterization. Typically, commercially available such as steel drums,containers will be used. The types of containers used for packaging nonradioactive dangerous waste will comply with the receiving TSD waste acceptance criteria and transportation requirements. However, final container selection, container and waste compatibility, and the need for liners will be based on the physical and chemical properties of the waste being managed.

4.2.1.2 Container Management Practices [D-1b]

The following paragraphs describe how each of the containers used at the WTP are managed.

4.2.1.2.1 Immobilized Glass Waste Containers

Immobilized glass waste ILAW containers and IHLW canisters will be moved remotely due to the high radiation content of the waste. A brief discussion of how the containers move through the WTP is presented below. ~~The schematics of the locations for container storage areas located within the three plants are River Protection Project Waste Treatment Plant found in Appendix 4A. Stand-alone container storage area location schematics are found in Appendix 2A.~~

ILAW Containers

An empty container will be transported to a LAW glass pour cave and placed on a turntable designed to hold three containers. There are two ILAW pour caves at each melter, each with the capacity to manage three containers at a time. The container will be sealed to the ~~melter~~Melter discharge with a pour head connection. The glass waste will fill the container during the course of approximately ~~15 to 20~~10 hours. ~~The filled container will cool for 10 to 30 hours to reach glass transition temperature (approximately 400 °C to 500 °C), which characterized the transformation from an equilibrated melt to a "frozed" glassstructure. At this stage, the waste glass does not containliquid and is in a viscous state that ultimately stabilizes to a solid.~~

The filled ILAW container will be lowered back onto the turntable. The filled container will cool for 10 to 30 hours to reach glass transition temperature (approximately 400 °C to 500 °C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure. At this stage, the waste glass does not contain liquid and is in a viscous state that ultimately stabilizes to a solid. Once the container has cooled, it will be rotated to the ~~import/export~~ transfer position. The container will then be lifted by a remotely operated crane onto a bogie and transported to the finishing line. In the event the finishing line becomes backed up, the container may be transported to the ILAW ~~buffer~~ container buffer storage ~~area~~ containment building. The containers will not be stacked. Storage area dimensions ~~and maximum waste storage volumes~~ are summarized in Table 4-12.

The container will be transported to the ILAW container finishing ~~containment building~~ line (see Section 4.2.4), where the level of waste glass will be measured and additional inert filler will be added, if needed~~to fill the container~~. A sample of the glass may also be collected in this location prior to inert filling. Glass within the neck of the container will be removed by abrasion and the lid will be attached to the container. The debris generated from residual glass removal will be collected with a vacuum system and disposed of as a secondary waste.

After the lid ~~welding~~ is mechanically sealed, the container will be moved to ~~one of two~~ the decontamination cell~~s in the containment building unit~~ where contamination will be removed. Using a turntable, the container will revolve while a power manipulator tracks the entire surface with decontamination equipment. The dry decontamination process will use carbon dioxide pellets. The container will then be transported to ~~one~~ of the ~~two ILAW~~swabbing cell, where its surface will be swabbed~~ with a soft absorbent material~~. The radiation levels of the swab will be remotely monitored, and the results will determine whether the ILAW container will ~~go to the ILAW container storage area~~ be ready for transportation to the disposal site, or go through decontamination again.

~~A container may also be transported to the ILAW container fixative area, where a fixative can be sprayed onto the its surface to immobilize detected radiological contamination. The container will then be transferred to the ILAW fixative curing cell area, where the fixative will be allowed to set. Container rework may also occur in this area. The container will then be moved to the ILAW container storage area. The containers will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.~~

~~When the container is ready to be shipped out of the ILAW container storage area it will be transported to the export area, where it will be placed into a cask.~~

IHLW Canisters

The empty canister will be remotely transported to ~~one of~~ the ~~two~~ IHLW pour station. The canister will be sealed to the melter pour spout with a pour head ~~and glass waste will fill the canister during the course of approximately two days~~. After filling, ~~a temporary lid will be placed on~~ the canister ~~which~~ will be allowed to cool to glass transition temperature (approximately 400 °C to 500 °C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure, prior to transportation to the IHLW canister weld containment building unit (see Section 4.2.4).

The IHLW canister will be transferred to the IHLW canister ~~weld~~ handling cave containment building unit by means of ~~an overhead crane~~ bogie. Here it will be stored on an open rack for up to three days, until it cools to normal operating temperature. Normal operating temperature is the temperature at which the canister can be lidded. This temperature range is 70 °F to 350 °F. In addition to providing a cooling area, the IHLW canister handling cave containment building unit can be used as a buffer to hold canisters awaiting lid welding or decontamination.

After it has cooled, the volume of glass in the canister will be determined. The canister will then be inspected for glass spatter on its exterior. If glass is found, it will be removed using a needle gun, and the debris generated will be collected with a vacuum system and disposed of as a secondary waste. ~~The temporary lid will be removed and residue on the lid or within the neck of the canister will be removed by abrasion.~~ The lid will be attached by welding, to seal the canister completely and permanently.

The sealed canister will be transported to the ~~IHLW~~canister ~~decontamination containment building unit~~decon cave (HB035). The canisters are first rinsed with de-ionized water and then decontaminated using a cerium nitrate and nitric acid bath. It will then be rinsed with nitric acid, followed by a de-ionized water rinse, and then wiped or swabbed with a soft absorbent material ~~in~~ at the canister swabbing and monitoring area near the canister decontamination vessels. The radiation levels of the swab will be monitored.

The canister will then be moved to the IHLW canister storage ~~area~~ cave (H-0132) where it will be stored until transported off-site inside a shielded shipping cask. The canisters will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.