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EDMC#: 0068956
SECTION: 2 OF 4

DOCUMENT #:

TITLE: Modification of RCRA Permit for TSD of Dangerous Waste Rev 008 to Incorporate Final Permit Conditions for IDF

ii. The Permittees shall construct all containment systems for the HLW Vitrification System as specified in Attachment 51, Chapter 4.0 of this Permit, and Attachment 51, 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. The Permittees shall 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 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."

iv. The Permittees must ensure that proper handling procedures are adhered to in order to prevent damage to the HLW Vitrification System during installation. Prior to covering, enclosing, or placing the new HLW Vitrification System or component in use, an independent, qualified, installation inspector or an independent, qualified, registered professional engineer, either of whom is trained and experienced in the proper installation of similar systems or components, must inspect the system for the presence of any of the following items:

A. Weld breaks;

B. Punctures;

C. Scrapes of protective coatings;

D. Cracks;

E. Corrosion;

F. Other structural damage or inadequate construction/installation.

All discrepancies must be remedied before the HLW Vitrification system is covered, enclosed, or placed in use [WAC 173-303-640(3)(c), in accordance with WAC 173-303-680(2) and (3)].

v. For the HLW Vitrification System or components that are placed underground and that are back-filled, the Permittees must provide a backfill material that is a non-corrosive, porous, homogeneous substance. The backfill must be installed so that it is placed completely around the HLW Vitrification System and compacted to ensure that the HLW Vitrification System is fully and uniformly supported [WAC 173-303-640(3)(d), in accordance with WAC 173-303-680(2) and (3)].

vi. The Permittees must test for tightness the HLW Vitrification System or components, prior to being covered, enclosed, or placed into use. If the HLW Vitrification System or components are found not to be tight, all repairs necessary to remedy the leak(s) in the system must be performed prior to the HLW Vitrification System being covered, enclosed, or placed in use [WAC 173-303-640(3)(e), in accordance with WAC 173-303-680(2) and (3)].

vii. The Permittees must ensure the HLW Vitrification System equipment is supported and protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction [WAC 173-303-640(3)(f), in accordance with WAC 173-303-680(2) and (3)].

viii. The Permittees must provide the type and degree of corrosion protection recommended by an independent corrosion expert, based on the information provided in Attachment 51, Appendices 10.9 and 10.11 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.b.i., III.10.J.5.b.iv., III.10.J.5.b.v., III.10.J.5.c.i., III.10.J.5.c.iv., III.10.J.5.c.v., III.10.J.5.d.i., III.10.J.5.d.iv., and III.10.J.5.d.v., or other corrosion protection if Ecology believes other corrosion protection is necessary to ensure the integrity of the HLW Vitrification System during use of the HLW Vitrification System. The installation of a corrosion protection system that is field fabricated must be supervised by an independent corrosion expert to ensure proper installation [WAC 173-303-640(3)(g), in accordance with WAC 173-303-680(2) and (3)].

ix. Prior to initial receipt of dangerous and/or mixed waste in the WTP Unit, the Permittees shall 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)].

x. The independent HLW Vitrification System installation inspection and subsequent written statements shall 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 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.

xi. The Permittees shall 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 Attachment 51, 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 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.

xii. The Permittees shall 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 Attachment 51, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c.

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 be equipped with operational alarms to warn of deviation, or imminent deviation from the limits specified in Permit Table III.10.J.F.

xiv. The Permittees shall 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 Attachment 51, 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.

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

xvi. The Permittees shall 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).

xvii. The Permittees shall 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 Attachment 51, 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)].

xviii. For routinely non-accessible HLW Vitrification System sub-systems, as specified in Attachment 51, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition

III.10.J.5.e.vi., the Permittees shall 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)].

xix. For all HLW Vitrification System sub-systems not addressed in Permit Condition III.10.J.1.a.xviii., the Permittees shall 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)].

xx. The Permittees shall 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 be investigated and repaired in accordance with Attachment 51, 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].

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)].

xxii. An impermeable coating, as specified in Attachment 51, 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 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 meet the requirements of WAC 173-303-640(4)(e)(ii)(C), in accordance with WAC 173-303-680(2). The coating shall prevent migration of any dangerous and mixed waste into the concrete. All coatings shall 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)].

xxiii. The Permittees shall 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 Attachment 51, 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 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 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 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 Attachment 51, 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 Attachment 51, 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 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 notify and report releases to the environment to Ecology, as specified in WAC 173-303-640(7)(d).

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 provide the information in A, B, and C, listed below. The Permittees shall 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.

xxv. All air pollution control devices and capture systems in the HLW Vitrification System shall 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 be established.

xxvi. In all future narrative permit submittals, the Permittees shall include HLW Vitrification sub-system names with the sub-system designation.

xxvii. Modifications to approved design, plans, and specifications in Attachment 51 of this Permit for the HLW Vitrification System shall 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.

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

xxix. For each HLW Vitrification System sub-system holding dangerous waste which are acutely or chronically toxic by inhalation, the Permittees shall 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

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

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

Where:

W_{in}=mass feedrate 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.

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

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

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

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

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

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

viii. Carbon monoxide (CO) emission from the HLW Vitrification System shall 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)].

ix. Hydrocarbon emission from the HLW Vitrification System shall 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)]:

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 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 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.

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 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 Attachment 51, 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, Attachment 51, Appendix 6.3.1 shall 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)].

xii. Compliance with the operating conditions specified in Permit Condition III.10.J.1.c., shall 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 operate the HLW Vitrification System in accordance with Attachment 51, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., and Attachment 51, Appendix 10.18 of this Permit, as approved pursuant to Permit Condition III.10.J.5.e., and Attachment 51, 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:

i. The Permittees shall 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.

ii. The Permittees shall 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. The Permittees shall 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

iv. The Permittees shall 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 mean if any portion of the HLW Vitrification System is bypassed so that gases are not treated as during the Demonstration Test.

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 immediately, manually cut-off the dangerous and mixed waste feed to the HLW Vitrification System. The Permittees shall not restart the dangerous and/or mixed waste feed until the problem causing the malfunction has been identified and corrected.

vi. The Permittees shall 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.

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 submit a written report to Ecology within five (5) calendar days of the thirty-first exceedance 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.

viii. If any portion of the HLW Vitrification System is bypassed while treating dangerous and/or mixed waste, it shall 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 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.

ix. The Permittees shall control fugitive emissions from the HLW Vitrification System by maintaining the melter under negative pressure.

x. Compliance with the operating conditions specified in Permit Condition III.10.J.1.c. shall 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 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)].

i. The Permittees shall inspect the HLW Vitrification System in accordance with the Inspection Schedules in Attachment 51, Chapter 6.0 of this Permit, as modified in accordance with Permit Condition III.10.C.5.c.

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

iii. The Permittees shall comply with the inspection requirements specified in Attachment 51, 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)]

i. Upon receipt of a written request from Ecology, the Permittees shall 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.

ii. The Permittees shall comply with the monitoring requirements specified in Attachment 51, 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. The Permittees shall 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 Attachment 51 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.

iv. The Permittees shall 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 Attachment 51, 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)]

i. The Permittees shall 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.

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

iii. The Permittees shall 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.

iv. The Permittees shall 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 close the HLW Vitrification System in accordance with Attachment 51, 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 be conducted in accordance with Permit Condition III.10.J.1., Attachment 51, 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

i. The shakedown period for the HLW Vitrification System shall begin with the initial introduction of dangerous waste in the HLW Vitrification System following construction and shall end with the start of the demonstration test.

ii. The shakedown period shall 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. Shakedown Phase 2 shall 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

i. The Permittees may feed the dangerous waste specified for the HLW Vitrification System on the Part A Forms (Attachment 51, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Attachment 51, 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.

ii. The Permittees shall 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. The Permittees shall not feed the following waste to the HLW Vitrification System during Shakedown Phase 2:

A. Mixed waste

iv. The feed-rates to the HLW Vitrification System shall 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.

v. The Permittees shall 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

i. The Permittees shall operate, monitor, and maintain the HLW Vitrification System as specified in Permit Condition III.10.J.1., and Attachment 51, 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.

ii. Attachment 51, Appendix 10.15 of this Permit, as approved pursuant to Permit Condition III.10.J.5.f., shall 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 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. The Permittees shall 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 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

i. The Permittees may feed the dangerous waste specified for the HLW Vitrification System in Part A Forms (Attachment 51, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Attachment 51, 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.

ii. The Permittees shall not feed mixed waste to the HLW Vitrification System.

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

v. The Permittees shall 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

i. The Permittees shall 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.

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 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. After successful completion of the Demonstration Test and receipt of Ecology's approval, the Permittees shall 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.

iv. RESERVED

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 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 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.

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 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, 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 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 be accompanied by a request for approval to retest as a permit modification pursuant to Permit Conditions II.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 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 III.10.C.2.f. The revised Demonstration Test Plan must include substantive changes to prevent failure from reoccurring.

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 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 exceedance 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, 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 operate, monitor, and maintain the HLW Vitrification System as specified in Permit Condition III.10.J.1. and Attachment 51, 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

i. The Permittees may feed the dangerous and/or mixed waste specified for the HLW Vitrification System on the Part A Forms (Attachment 51, Chapter 1.0 of this Permit), except for those waste outside the waste acceptance criteria specified in the WAP, Attachment 51, 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.

ii. The dangerous waste and mixed waste feed rates to the HLW Vitrification System shall 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. The Permittees shall 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 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 Attachment 51, 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):

i. IQRPE Reports (specific to foundation, secondary containment, and leak detection system) shall include review of design drawings, calculations, and other information on which the certification report is based and shall include, but not limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Attachment 51, Appendix 10.0 of this Permit, may be included in the report by reference and should include drawing and document numbers. IQRPE Reports shall 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)];

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. The Permittees shall 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 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)];

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)];

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)];

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);

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;

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)];

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 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 Attachment 51, 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):

i. IQRPE Reports (specific to sub-system) shall include review of design drawings, calculations, and other information on which the certification report is based and shall include as applicable, but not limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Attachment 51, 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 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)];

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. 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 be submitted for incorporation into the Administrative Record. Documentation shall 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)];

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)];

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)];

vi. Sub-system vendor information (including, but not limited to, required performance warranties, as available), consistent with information submitted under ii. above, 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)(v)];

vii. System descriptions (process) related to sub-system units shall 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)];

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)];

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

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);

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)];

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 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 Attachment 51, 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):

i. IQRPE Reports (specific to sub-system equipment) shall include a review of design drawings, calculations, and other information as applicable on which the certification report is based. The reports shall include, but not be limited to, review of such information described below. Information (drawings, specifications, etc.) already included in Attachment 51, 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 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)];

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. 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)];

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)];

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)];

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 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)];

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)];

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)];

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)];

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)];

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)];

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)];

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 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 submit to Ecology, pursuant to Permit Condition III.10.C.9.f., the following as specified below for incorporation into Attachment 51, Appendix 10.18 of this Permit, except Permit Condition III.10.J.5.e.i., which will be incorporated into Attachment 51, 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:

i. Integrity assessment program and schedule for the HLW Vitrification System shall 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)];

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. 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)];

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);

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)];

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.

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).

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.

ix. Permit Table III.10.J.C and III.10.K.C shall be 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 Attachment 51, 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 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)];

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 Attachment 51, 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 submit for review and receive approval for incorporation into Attachment 51, 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 Attachment 51, Appendix 10.15, Permit Condition III.10.C.2.g. process will be followed. The Demonstration Test Plan shall include, but not be limited to, the following information. The Demonstration Test Plan shall 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 Attachment 51, 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 Attachment 51, Appendix 10.15, shall be incorporated by reference in Attachment 51, Chapter 6.0 of this Permit.

Notes: (1) The following should be consulted to prepare this Demonstration Test Plan: "Guidance on Setting Permit Conditions and Reporting Trial Burn Results Volume II of the Hazardous Waste Incineration Guidance Series", and EPA/625/6-89/019 and Risk Burn Guidance For Hazardous Waste Combustion Facilities", EPA-R-01-001, July 2001, WAC 173-303-807(2), WAC 173-303-670(5), WAC-173-303-670(6), 40 CFR §63.1207(f)(2), 40 CFR §63.1209 and Appendix to 40 CFR Part 63 EEE.

(2) Cross-referencing to the information provided pursuant to permit Conditions III.H.5.b., c., d., e. and III.10.C.3.e.v., as approved by Ecology, that are redundant to elements of the Demonstration Test Plan for the HLW Vitrification System is acceptable.

i. Analysis of each feed-stream to be fed during the demonstration test, including dangerous waste, glass formers and reductants, process streams (e.g., control air, process air, steam, sparge bubbler air, air in-leakage from melter cave, and gases from HLW Vitrification Vessel Ventilation System, process water, etc.) that includes:

A. Levels of ash, levels of metals, total chlorine (organic and inorganic), other halogens and radionuclide surrogates.

B. Description of the physical form of the feed-streams;

C. An identification and quantification of organics that are present in the feed-stream, including constituents proposed for DRE demonstration;

A comparison of the proposed demonstration test feed streams to the mixed waste feed envelopes to be processed in the melter must be provided that documents that the proposed demonstration test feed streams will serve as worst case surrogates for organic destruction, formation of products of incomplete oxidation, and metals, total chlorine (organic and inorganic), other halogens, particulate formation, and radionuclides;

ii. Specification of trial principal organic dangerous constituents (PODCs) for which destruction and removal efficiencies are proposed to be calculated during the demonstration test and for inclusion in Permit Conditions III.10.J.1.b.i. and III.10.K.1.b.i. These trial PODCs shall be specified based on destructibility, concentration or mass in the waste and the dangerous waste constituents or constituents in WAC 173-303-9905;

iii. A description of the blending procedures, prior to introducing the feed-streams into the melter, including analysis of the materials prior to blending, and blending ratios;

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;

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 II.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 Attachment 51, Appendix 10.0 to reflect the addition of an oxygen monitor and the correction of the standards to seven percent (7%) oxygen.

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.

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;

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.;

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 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.

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.

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;

xii. A calculation of waste residence time;

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.

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.

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.

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)]

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**
Feed Preparation Vessel -VSL-00001/5[a], HLW Melter Feed Vessel -VSL-00002/6[a] (HLW Melter Feed Process System)	HFP HCP	**24590-HLW** -M5-V17T-P0001 -M6-HFP-P0001 -M6-HFP-P20001 -M6-HFP-P20002	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
HLW Glass Product System-Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
Film Cooler - Melter 1	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27
Submerged Bed Scrubber /Condensate Collection Vessels -HOP-SCB-00001/2 [a] - Melters 1 & 2	HOP	**24590-HLW** -M6-HOP-P0001 -M6-HOP-P20001 -MK-HOP-P0001001 -MK-HOP-P0001002 -MK-HOP-P0001003 -MK-HOP-P0001004 -MKD-HOP-P0016 -N1D-HOP-P0010 -MVD-HOP-P0015 -MVD-HOP-P0016	Section 4.1.4.3; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-28
Wet Electrostatic Precipitator-Melter 1 HOP-WESP-00001 HOP-WESP-00002	HOP	**24590-HLW** -HOP-WESP-00001 -HOP-WESP-00002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-28
High Efficiency Particulate Air 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** -M6-HOP-P0010 -M6-HOP-P20010	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Activated Carbon Adsorber (HOP-ADBR-00001A/B) Activated Carbon Absorber (HOP-ADBR-00002A/B)	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MVD-HOP-P0015 -MVD-HOP-P0016 -WTP-3PS-MWKO-TP001	Section 4.1.4.3; 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**
High Efficiency Mist Eliminators - Melters 1/2 -HOP-HEME-00001A/1B, -HOP-HEME-00002A/2B	HOP	**24590-HLW** -M6-HOP-P0002 -M6-HOP-P0009 -M6-HOP-P20009 -MKD-HOP-P0007 -MV-HOP-P0002001 -MV-HOP-P0002002 -MV-HOP-P0002003 -MVD-HOP-P0015 -MVD-HOP-P0016 -N1D-HOP-P0001	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-28
Thermal Catalytical Oxidation Unit	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Selective Catalytical Reduction Unit	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Melter 1 Silver Mordenite Column HOP-ABS-00002, Melter 2 Silver Mordenite Column-HOP-ABS-00003	HOP	**24590-HLW** -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 -3PS-MBTO-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Electric Heaters-HOP-HTR-00002A/1B;-	HOP	**24590-HLW** -M6-HOP-P0010	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Heat Exchangers-ME-HOP-HX-00002/4	HOP	**24590-HLW** -MED-HOP-P0012 -MED-HOP-P0017	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
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
Booster Fans-MA-HOP-FAN-00001A/1B/1C, MA-HOP-FAN-00009A/9B/9C	HOP	**24590-HLW** -MAD-HOP-P0018 -MAD-HOP-P0019 -MAD_HOP_P0020 -MAD-HOP-P0035 -MAD-HOP-P0036 -MAD-HOP-P0037	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
HLW Stack	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Electric Heater (PJV-HTR-00002)	PJV (HLW Pulse Jet Ventilation Treatment System)	**24590-HLW** -M6-PJV-POOO1 -M5-V17T-P0005	RESERVED
High Efficiency Particulate Air Filters –	PJV (HLW	**24590-HLW**	RESERVED

Sub-system Description	Sub-system Designatio n	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables, and Figures
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)	Pulse Jet Ventilation Treatment System)	-M6-PJV-POOO2 -M5-V17T-P0005	
Booster Fans (PJV-FAN-00002A/B)	PJV (HLW Pulse Jet Ventilation Treatment System)	**24590-HLW** -M6-PJV-POOO2 -M5-V17T-P0005	RESERVED

a. Requirements pertaining to the tanks in HLW Vitrification System Melter Feed System, Submerged Bed Scrubber/Condensate 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

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	Expected Range	Fail States	Instrument Accuracy	Instrument Calibration Method No. and Range
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 be used as defined in Permit Section III.10.C.1.

[1]Maximum Feed-rate shall 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 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 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 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 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]

i. The Permittees shall maintain the design and construction of the HLW Vitrification System as specified in Permit Condition III.10.K.1, Attachment 51, Chapter 4.0 of this Permit, and Attachment 51, 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.

ii. The Permittees shall maintain the design and construction of all containment systems for the HLW Vitrification System as specified in Attachment 51, Chapter 4.0 of this Permit, and Attachment 51, 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. Modifications to approved design, plans, and specifications in Attachment 51, of this Permit, for the HLW Vitrification System shall 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.

iv. The Permittees shall 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."

v. The Permittees shall 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 Attachment 51, 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 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.

vi. The Permittees shall 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 Attachment 51, Chapter 6.0 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e.i. and III.10.C.5.c.

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 be equipped with operational alarms to warn of deviation, or imminent deviation from the limits specified in Permit Table III.10.K.F.

viii. The Permittees shall 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 Attachment 51, 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.

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

x. The Permittees shall 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).

xi. The Permittees shall 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 Attachment 51, 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)].

xii. For routinely non-accessible HLW Vitrification System sub-systems, as specified in Attachment 51, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., the Permittees shall 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)].

xiii. For all the HLW Vitrification System sub-systems not addressed in Permit Condition III.10.K.1.a.xii., the Permittees shall 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)].

xiv. The Permittees shall 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 be investigated and repaired in accordance with Attachment 51, 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].

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)].

xvi. An impermeable coating, as specified in Attachment 51, 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 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 meet the requirements of WAC 173-303-640(4)(e)(ii)(C), in accordance with WAC 173-303-680(2). The coating shall prevent migration of any dangerous and/or mixed waste into the concrete. All coatings shall 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)].

xvii. The Permittees shall 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 Attachment 51, 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 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 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 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 Attachment 51, 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 Attachment 51, 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 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 notify and report releases to the environment to Ecology as specified in WAC 173-303-640(7)(d).

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 provide the information in A, B, and C, listed below. The Permittees shall 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.

xix. All air pollution control devices and capture systems in the HLW Vitrification System shall 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 be established.

xx. In all future narrative permit submittals, the Permittees shall include HLW Vitrification sub-system names with the sub-system designation.

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

xxii. For each HLW Vitrification System sub-system holding dangerous waste which are acutely or chronically toxic by inhalation, the Permittees shall 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

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 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.

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

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

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

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

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

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

viii. Carbon monoxide (CO) emission from the HLW Vitrification System shall 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)];

ix. Hydrocarbon emission from the HLW Vitrification System shall 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)];

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 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 exceedance 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, 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 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.

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 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 Attachment 51, 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, Attachment 51, Appendix 6.3.1 shall 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)].

xii. Compliance with the operating conditions specified in Permit Condition III.10.K.1.c., shall 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 operate the HLW Vitrification System in accordance with Attachment 51, Chapter 4.0 of this Permit, as updated pursuant to Permit Condition III.10.J.5.e.vi., Attachment 51, Appendix 10.18 of this Permit, as approved pursuant to Permit Conditions III.10.J.5.e. and f., and Attachment 51, 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:

i. The Permittees shall 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.

ii. The Permittees shall 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. The Permittees shall 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.

iv. The Permittees shall 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 mean if any portion of the HLW Vitrification System is bypassed so that gases are not treated as during the Demonstration Test.

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 immediately, manually, cut-off the dangerous and/or mixed waste feed to the HLW Vitrification System. The Permittees shall not restart the dangerous and/or mixed waste feed until the problem causing the malfunction has been identified and corrected.

vi. The Permittees shall 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.

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 submit a written report to Ecology within five (5) calendar days of the thirty-first (31) exceedance 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.

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 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 exceedance. 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.

ix. If any portion of the HLW Vitrification System is bypassed while treating dangerous and/or mixed waste, it shall 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 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.

x. The Permittees shall control fugitive emissions from the HLW Vitrification System by maintaining the melter under negative pressure.

xi. Compliance with the operating conditions specified in Permit Condition III.10.K.1.c. shall 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 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)]

i. The Permittees shall inspect the HLW Vitrification System in accordance with the Inspection Schedules in Attachment 51, Chapter 6.0 of this Permit, as modified in accordance with Permit Condition III.10.C.5.c.

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

iii. The Permittees shall comply with the inspection requirements specified in Attachment 51, 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)]

i. Upon receipt of a written request from Ecology, the Permittees shall 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.

ii. The Permittees shall comply with the monitoring requirements specified in the Attachment 51, 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. The Permittees shall 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 Attachment 51 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.

iv. The Permittees shall operate, calibrate, and maintain the instruments specified on Permit Tables III.10.K.C and F, as approved/modified pursuant to Permit Conditions III.10.J.5 and III.J.3.d.v., in accordance with Attachment 51, 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)]

i. The Permittees shall 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.

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

iii. The Permittees shall 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.

iv. The Permittees shall 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 close the HLW Vitrification System in accordance with Attachment 51, 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)]

i. Dioxin and Furan Emission Testing

A. Within eighteen (18) months of commencing operation pursuant to Permit Section III.10.K, the Permittees shall 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 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 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 Attachment 51, 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 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 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 implement the DFETP approved, pursuant to Permit Condition III.10.K.1.h.i.A.

C. The Permittees shall 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 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 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 submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports shall 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 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, 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 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 exceedance 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, 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.

ii. Non-organic Emission Testing

A. Within forty-eight (48) months of commencing operation pursuant to Permit Section III.10.K, the Permittees shall 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 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 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 Attachment 51, 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 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 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 implement the RDTP approved pursuant to Permit Condition III.10.K.1.h.ii.A.

C. The Permittees shall 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 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 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 submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports shall 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 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 exceedance 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, 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 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, 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. Other Emission Testing

A. Within seventy-eight (78) months of commencing operation pursuant to Permit Section III.10.K, the Permittees shall 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 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 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 Attachment 51, 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 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 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 implement the RDTP approved pursuant to Permit Condition III.10.K.1.h.iii.A.

C. The Permittees shall 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 submit to Ecology the complete test report within ninety (90) calendar days of completion of the testing. The test reports shall 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 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, 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 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 exceedance of the emission rate(s) and submit a report of the investigation findings to Ecology within fifteen (15) days of the discovery of the exceedance of the emission rate(s); and

3. Based on the notification and any additional information, Ecology may submit, 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.

1 **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
Feed Preparation Vessel -VSL-00001/5[a], HLW Melter Feed Vessel VSL-00002/6[a] (HLW Melter Feed Process System)	HFP HCP	**24590-HLW** -M5-V17T-P0001 -M6-HFP-P0001 -M6-HFP-P20001 -M6-HFP-P20002 -PER-J-04-0001 -3YD-HFP-00001	Section 4.1.4.1; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-26
HLW Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
HLW Glass Product System-Melter 1	HMP	RESERVED	Section 4.1.4.2; Figures 4A-1, 4A-4, 4A-27
Film Cooler - Melter 1	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-27
Submerged Bed Scrubber /Condensate Collection Vessels HOP-SCB-00001/2 [a] - Melter 1/2	HOP	**24590-HLW** -M6-HOP-P0001 -M6-HOP-P20001 -MVD-HOP-P0015 -MVD-HOP-P0016 -MK-HOP-P0001001 -MK-HOP-P0001002 -MK-HOP-P0001003 -MK-HOP-P0001004 -MKD-HOP-P0016 -N1D-HOP-P0010	Section 4.1.4.3; Table 4-5 & 4-11, Figures 4A-1, 4A-4, 4A-28
Wet Electrostatic Precipitator-Melter 1 HOP-WESP-00001 HOP-WESP-00002	HOP	**24590-HLW** HOP-WESP-00001 HOP-WESP-00002	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-28
High Efficiency Particulate Air Filters - Melters 1/2 -HOP-HEPA-1A/1B, HOP-HEPA-2A/2B, HOP-HEPA-0000&A/7B,HOP-HEPA-00012A/B HOP-HEPA-00008A/8B, HOP-HEPA-00013A/B	HOP	**24590-HLW** -M6-HOP-P0010 -M6-HOP-P20010	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Activated Carbon (HOP-ADBR-00001A/B) Activated Carbon Absorber (HOP-ADBR-00002A/B)	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P20003 -MVD-HOP-P0015 -MVD-HOP-P0016 -WTP-3PS-MWKO-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29

Sub-system Description	Subsystem Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables and Figures
High Efficiency Mist Eliminators-HOP-HEME-00001A/1B, HOP-HEME-00002A/2B	HOP	**24590-HLW** -M6-HOP-P0002 -M6-HOP-P20009 -MKD-HOP-P0007 -MV-HOP-P0002001 -MV-HOP-P0002002 -MV-HOP-P0002003 -N1D-HOP-P0001	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-28
Thermal Catalytical Oxidation Unit	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Selective Catalytical Reduction Unit	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Melter 1 Silver Mordenite Column - HOP-ABS-00002, Melter 2 Silver Mordenite Column -HOP-ABS-00003	HOP	**24590-HLW** -M5-V17T-P0004 -M5-V17T-P20004 -M6-HOP-P0003 -M6-HOP-P0004 -M6-HOP-P0006 -M6-HOP-P0008 -M6-HOP-P20003 -M6-HOP-P20008 -MKD-HOP-P0014 -MKD-HOP-P0017 -MV-HOP-P0001 -MVD-HOP-P0001 -MVD-231-00001 -NID-HOP-P0006 -3PS-MBTO-TP001	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Electric Heaters -HOP-HTR-00002A/1B, HOP-HTR-00005A/5B	HOP	**24590-HLW** -M6-HOP-P0010 -M6-HOP-P20010	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Heat Exchangers-ME-HOP-HX-00002/4	HOP	**24590-HLW** -MED-HOP-P0012 -MED-HOP-P0017	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
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
Booster Fans-MA-HOP-FAN-00001A/1B/1C, MA-HOP-FAN-00009A/9B/9C	HOP	**24590-HLW** -MAD-HOP-P0018 -MAD-HOP-P0019 -MAD_HOP_P0020 -MAD-HOP-P0035 -MAD-HOP-P0036 -MAD-HOP-P0037	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
HLW Stack	HOP	RESERVED	Section 4.1.4.3; Figures 4A-1, 4A-4, 4A-29
Electric Heater (PJV-HTR-00002)	PJV (HLW Pulse Jet Ventilation Treatment System)	**24590-HLW** -M6-PJV-POOO1 -M5-V17T-P0005	RESERVED

Sub-system Description	Subsystem Designation	Engineering Description (Drawing Nos., Specification Nos., etc.)	Narrative Description, Tables and Figures
High Efficiency Particulate Air 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** -M6-PJV-POOO2 -M5-V17T-P0005	RESERVED
Booster Fans (PJV-FAN-00002A/B)	PJV (HLW Pulse Jet Ventilation Treatment System)	**24590-HLW** -M6-PJV-POOO2 -M5-V17T-P0005	RESERVED

a. Requirements pertaining to the tanks in HLW Vitrification System Melter Feed System, Submerged Bed Scrubber/Condensate Vessels are specified in Permit Section 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 be used as defined in Permit Section III.10.C.1.

[1]Maximum Feed-rate shall 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

OPERATING UNIT 11

Integrated Disposal Facility

This document sets forth the operating conditions for the Integrated Disposal Facility (IDF).

II.11.A COMPLIANCE WITH APPROVED PERMIT

The Permittees shall comply with all requirements set forth in the Integrated Disposal Facility (IDF) Permit conditions, the Appendices specified in condition III.11.A and the Amendments specified in Condition III.11.B through III.11.I. All subsections, figures, and tables included in these portions are enforceable unless stated otherwise:

<u>OPERATING UNIT 11, ATTACHMENT 52:</u>

Part A, Dangerous Waste Permit, Revision 3, dated 3/2005

Chapter 2.0	Topographic Map Description
Chapter 3.0	Waste Analysis Plan
Chapter 4.0	Process Information
Chapter 5.0	Ground Water Monitoring
Chapter 6.0	Procedure to Prevent Hazards
Chapter 7.0	Contingency Plan
Chapter 8.0	Personnel Training
Chapter 11.0	Closure and Post Closure Requirements
Chapter 13.0	Other Federal and State Laws
Appendix 4A	Design Report (as applicable to critical systems)
Appendix 4B	Construction Quality Assurance Plan
Appendix 4C	Response Action Plan
Appendix 4D	Technical specifications document (RPP-18-489 Rev 0)
Appendix 7A	Building Emergency Plan (As applicable in Chapter 7)
Appendix 8A	Training Plan

General and Standard Hanford Facility RCRA Permit, WA7890008967 (Permit) conditions (Part I and Part II conditions) applicable to the IDF are identified in Permit Attachment 3 (Permit Applicability Matrix).

III.11.B. AMENDMENTS TO THE APPROVED PERMIT

III.11.B.1. Portions of Permit Attachment 4, Hanford Emergency Management Plan that are not made enforceable by inclusion in the applicability matrix for that document, are not made enforceable by reference in this document.

III.11.B.2 Permittees must comply with all applicable portions of the Permit. The facility and unit-specific recordkeeping requirements are distinguished in the General Information Portion of the Permit, and are tied to the Permit conditions.

III.11.B.3 The scope of this Permit is restricted to the landfill construction and operation as necessary to dispose of: 1) immobilized low activity waste from the WTP, and 2) the Demonstration Bulk Vitrification System and IDF operational waste as identified in Chapter 4.0. Future expansion of the RCRA trench, or disposal of other wastes not specified in this Permit, is prohibited unless authorized via modification of this Permit.

III.11.B.4 In accordance with WAC 173-303-806(11)(d), this Permit shall be reviewed every five (5) years after the effective date and modified, as necessary, in accordance with WAC 173-303-830(3).

III.11.C DESIGN REQUIREMENTS

III.11.C.1 IDF is designed in accordance with WAC 173-303-665 and WAC 173-303-640 as described in Chapter 4.0. Design changes impacting IDF critical systems shall be performed in accordance with Conditions III.11.D.1.d.i and III.11.D.1.d.ii.

IDF Critical Systems[1] include the following: The leachate collection and removal system (LCRS), leachate collection tank (LCT), leak detection system (LDS), liner system (LS), and closure cap. H-2 Drawings for the LCRS, LCT, LDS, and LS are identified in Appendix 4A, Section 3 of this Permit. Drawings for the closure cap will be provided pursuant to Condition III.11.C.1.b.

III.11.C.1.a The Permittees shall construct and operate the IDF in accordance with all specifications contained in RPP-18489 Rev 0. Critical systems, as defined in the definitions section of the Site-Wide RCRA Permit, are identified in Appendix 4A, Section 1 of this Permit.

III.11.C.1.b Landfill Cap

At final closure of the landfill, the Permittees shall cover the landfill with a final cover (closure cap) designed and constructed [WAC 173-303-665(6), WAC 173-303-806(4)(h)] to: Provide long-term minimization of migration of liquids through the closed landfill; Function with minimum maintenance; Promote drainage and minimize erosion or abrasion of the cover; Accommodate settling and subsidence so that the cover's integrity is maintained; and have a permeability less than or equal to the permeability of any bottom liner system or natural sub soils present.

III.11.C.1.c Compliance Schedule

Proposed conceptualized final cover design is presented in Chapter 11 (Closure and Financial Assurance). Six months prior to start of construction of IDF landfill final cover (but no later than 6 months prior to acceptance of the last shipment of waste at the IDF), the Permittees shall submit IDF landfill final cover design, specifications and CQA plan to Ecology for review and approval. No construction of the final cover may proceed until Ecology approval of the final design is given, through a permit modification.

III.11.C.1.d The Permittees shall notify Ecology at least sixty (60) calendar days prior to the date it expects to begin closure of the IDF landfill in accordance with WAC 173-303-610(c).

III.11.C.2 Design Reports

III.11.C.2.a New Tank Design Assessment Report

Permittees shall generate a written report in accordance with WAC 173-303-640(3)(a), providing the results of the leachate collection tank system design assessment. The report shall be reviewed and certified by an Independent Qualified Registered Professional Engineer (IQRPE)[2] in accordance with WAC-173-303-810(13)(a).

[2] "Independent qualified registered professional engineer," as used here and elsewhere with respect to Operating Unit 11, means a person who is licensed by the state of Washington, or a state which has reciprocity with the state of Washington as defined in RCW 18.43.100, and who is not an employee of the owner or operator of the facility for which construction or modification certification is required. A qualified professional engineer is an engineer with expertise in the specific area for which a certification is given.

III.11.C.2.b Compliance Schedule

Permittees shall submit the leachate collection tank design assessment report to Ecology along with the IQRPE certification, prior to construction of any part of the tank system including ancillary equipment.

III.11.D **<u>CONSTRUCTION REQUIREMENTS</u>**

III.11.D.1 Construction Quality Assurance

III.11.D.1.a Ecology shall provide field oversight during construction of critical systems. In cases where an Engineering Change Notices (ECN) and/or Non Conformance Report (NCR) is required, Ecology and the Permittees shall follow steps for processing changes to the approved design per Conditions III.11.D.1.d.i and III.11.D.1.d.ii.

III.11.D.1.b Permittees shall implement the Construction Quality Assurance Plan (CQA plan) (Appendix 4B of the permit) during construction of IDF.

III.11.D.1.b.i The Permittees will not receive waste in the IDF until the owner or operator has submitted to Ecology by certified mail or hand delivery a certification signed by the CQA officer that the approved CQA plan has been successfully carried out and that the unit meets the requirements of WAC173-303-665 (2)(h) or (j); and the procedure in WAC 173-303-810 (14)(a) has been completed. Documentation supporting the CQA officer's certification shall be furnished to Ecology upon request.

III.11.D.1.c Construction inspection reports

III.11.D.1.c.i Permittees shall submit a report documenting the results of the leachate tank installation inspection. This report must be prepared by an independent, qualified installation inspector or a professional independent, qualified, registered, professional engineer either of whom is trained and experienced in the proper installation of tank systems or components. The Permittees will remedy all discrepancies before the tank system is placed in use. This report shall be submitted to Ecology 90 days prior to IDF operation and be included in the IDF Operating Record. [WAC-173-303-640(3)(h)].

III.11.D.1.d ECN/NCR Process for Critical Systems

Portions of the following conditions for processing engineering change notices and non-conformance reporting were extracted from and supersede Site Wide General Permit Condition II.L.

III.11.D.1.d.i Engineering Change Notice for Critical Systems

During construction of the IDF, the Permittees shall formally document changes to the approved designs, plans, and specifications, identified in Appendices 4A, 4B, 4C, and 4D of this permit, with an Engineering Change Notice (ECN). The Permittees shall maintain all ECNs in the IDF unit-specific Operating Record and shall make them available to Ecology upon request or during the course of an inspection. The Permittees shall provide to Ecology copies of proposed ECNs affecting any critical system within five (5) working days of initiating the ECN. Identification of critical systems is included in Condition III.11.C.1 and Appendix 4A of this permit. Within five (5) working days, Ecology will review a proposed ECN modifying a critical system and inform the Permittees whether the proposed ECN, when issued, will require a Class 1, 2, or 3 Permit modification.

III.11.D.1.d.ii Non-conformance Reporting for Critical Systems

III.11.D.1.d.ii.a During construction of the IDF, the Permittees shall formally document with a Nonconformance Report (NCR), any work completed which does not meet or exceed the standards of the approved design, plans and specifications, identified in Appendices 4A, 4B, 4C and 4D of this permit,. The Permittees shall maintain all NCRs in the IDF unit-specific Operating Record and shall make them available to Ecology upon request, or during the course of an inspection

III.11.D.1.d.ii.b The Permittees shall provide copies of NCRs affecting any critical or regulated system to Ecology within five (5) working days after identification of the nonconformance. Identification of critical systems is included in Condition III.11.C.1 and Appendix 4A of this permit. Ecology will review a NCR affecting a critical system and notify the Permittees within five (5) working days, in writing, whether a Permit modification is required for any nonconformance, and whether prior approval is required from Ecology before work proceeds, which affects the nonconforming item. .

III.11.D.1.d.iii As-Built Drawings

Upon completing construction of IDF, the Permittees shall produce as-built drawings of the project, which incorporate the design and construction modifications resulting from all project ECNs and NCRs, as well as modifications made pursuant to WAC 173-303-830. The Permittees shall place the drawings into the Operating Record within twelve (12) months of completing construction.

III.11.D.2 The Permittees shall not reduce the minimum frequency of destructive testing less than one test per 500 feet of seam, without prior approval in writing from Ecology

III.11.E **GROUND WATER AND GROUND WATER MONITORING**

Ground water shall be monitored in accordance with WAC 173-303 and the provisions contained in the Ecology-approved facility ground water monitoring plan (Chapter 5.0).

All wells used to monitor the ground water beneath the unit shall be constructed in accordance with the provisions of WAC-173-160.

III.11.E.1 Ground Water Monitoring Program

III.11.E.1.a Prior to initial waste placement in the IDF landfill, the Permittees shall sample all ground water monitoring wells in the IDF network twice quarterly for one first year to determine baseline conditions. For the first sampling event (and only the first), samples for each well will include all constituents in 40 CFR 264 Appendix IX. Thereafter, sampling will include only those constituents as specified in Chapter 5.0, Table 5-2: chromium (filtered and unfiltered the first year to compare results), specific conductance, TOC, TOX, and pH. Other constituents to be monitored but not statistically compared include alkalinity, anions, ICP metals, and turbidity. These will provide important information on hydrogeologic characteristics of the aquifer and may provide indications of encroaching contaminants from other facilities not associated with IDF.

III.11.E.1.b After the baseline monitoring is completed, and data is analyzed, the Permittees and Ecology shall assess revisions to Chapter 5.0, Table 5-2. Subsequent samples will be collected semi-annually and will include constituents listed in Table 5-2 as approved by Ecology. All data analysis will employ Ecology approved statistical methods pursuant to WAC 173-303-645. Changes to chapter 5.0 will be subject to the permit modifications procedures under WAC 173-303-830.

III.11.E.1.c All constituents used as tracers to assess performance of the facility through computer modeling should be sampled at least annually to validate modeling results. Groundwater monitoring data and analytes to be monitored will be reviewed periodically as defined in Chapter 5.0 of this permit.

III.11.E.1.d Upon Ecology approval of the leachate monitoring plan, leachate monitoring and groundwater monitoring activities should be coordinated as approved by Ecology to form an effective and efficient means of monitoring the performance of the IDF facility.

III.11.E.1.e Ground water monitoring data shall be reported to Ecology on an annual basis beginning on March 1 after the issue date of this permit and annually on March 1after that.

III.11.F **<u>LEACHATE COLLECTION COMPONENT MANAGEMENT</u>**

Permittees shall design, construct, and operate all leachate collection systems to minimize clogging during the active life and post closure period

III.11.F.1 Leachate Collection and Removal System (LCRS)

III.11.F.1.a At least 120 days prior to initial waste placement in the IDF, the Permittees shall submit a Leachate monitoring plan to Ecology for review, approval, and incorporation into the permit. Upon approval by Ecology, this plan will be incorporated into the Permit as a class 1' modification. The Permittees shall not accept waste into the IDF until the requirements of the leachate monitoring plan have been incorporated into this permit.

III.11.F.1.b Leachate in the LCRS (primary sump) shall be sampled and analyzed monthly for the first year of operation of the facility and quarterly thereafter (pursuant to WAC 173-303-200). Additionally, leachate shall be sampled and analyzed to meet waste acceptance criteria at the receiving treatment storage and disposal facility.

III.11.F.1.c Permittees shall manage the leachate in the LCRS system in a manner that does not allow the fluid head to exceed 30.5 cm above the flat 50-foot by 50-foot LCRS sump HDPE bottom liner except for rare storm events as discussed in Chapter 4.0, Section 4.3.6.1 and the LCRS sump trough [(WAC 173-303-665(2)(h)(ii)(B). Liquid with a depth greater than 30.5 cm above the SLDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.1.d After initial waste placement, Permittees shall manage all leachate from the permitted cell as dangerous waste (designated with Dangerous Waste Number F039) in accordance with WAC 173- 303.

III.11.F.2 Monitoring and Management of Leak Detection System (LDS/ secondary sump)

III.11.F.2.a Permittees shall manage the leachate in the LDS system in a manner that does not allow the fluid head to exceed 30.5 cm above the LDS liner (WAC 173-303-665(2)(h)(ii)(B).

III.11.F.2.b Permittees shall monitor and record leachate removal for comparison to the Action Leakage Rate (ALR) as described in Appendix 4C, Response Action Plan. If the leachate flow rate in the LDS exceeds the ALR, the Permittees shall implement the Ecology approved response action plan (Appendix 4C).

III.11.F.2.c Leachate from the LDS (secondary sump) shall be sampled semi-annually if a pumpable quantity of leachate is available for sampling.

III.11.F.2.d Accumulated liquid of pumpable quantities in the LDS will be managed in a manner that does not allow the fluid head to exceed 30.5 cm above the LDS liner [WAC 173-303-665(2)(h)(i)(C)(iii)]. Liquid with a depth greater than 30.5 cm above the LDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.2.e Permittees shall manage all leachate from the permitted cell as F039 dangerous waste in accordance with WAC 173- 303.

III.11.F.3 Monitoring and Management of the Secondary Leak Detection System (SLDS)

III.11.F.3.a The Permittees shall submit to Ecology for approval a sub-surface liquids monitoring and operations plan (SLMOP) for the SLDS to include the following: monitoring frequency, pressure transducer configuration, liquid collection and storage processes, sampling and analysis and response actions. The SLMOP shall be approved by Ecology prior to placement of waste in the IDF, and incorporated into the Permit as a Class 1' modification.

III.11.F.3.b Permittees shall monitor and manage the SLDS (tertiary sump) pursuant to the approved sub-surface liquids monitoring and operations plan.

III.11.F.3.c Accumulated liquid of pumpable quantities in the SLDS will be managed in a manner that does not allow the fluid head to exceed 30.5 cm above the SLDS liner [WAC 173-303-665(2)(h)(i)(C)(iii)]. Liquid with a depth greater than 30.5 cm above the SLDS liner will be removed at the earliest practicable time after detection (not to exceed 5 working days).

III.11.F.3.d Permittees shall manage all leachate from the permitted cell as dangerous waste in accordance with WAC 173- 303.

III.11.G CONSTRUCTION WATER MANAGEMENT

III.11.G.1 During construction, it is anticipated that liquids will accumulate on top of all liners and sumps. Permittees shall manage the construction wastewater in accordance with State Waste Discharge Permit ST 4511.

III.11.G.2 Liquid accumulation within the LCRS, LDS, and SLDS prior to initial waste placement will be considered construction wastewater (i.e., not leachate).

III.11.H LANDFILL LINER INTEGRITY MANAGEMENT AND LANDFILL OPERATIONS

III.11.H.1 Permittees shall design, construct, and operate the landfill in a manner to protect the liners from becoming damaged. Temperature: Waste packages with elevated temperatures shall be evaluated and managed in a manner to maintain the primary (upper) liner below the design basis temperature for the liner (e.g.,160F). Weight: Waste, fill material and closure cover shall be placed in a manner that does not exceed the allowable load bearing capacity of the liner (weight per area 13,000 lb/ft2). Puncture: At least 3 feet of clean backfill material shall be placed as an operations layer over the leachate collection and removal system to protect the system from puncture damage.

III.11.H.1.a All equipment used for construction and operations inside of the IDF shall meet the weight limitation as specified in condition III.H.1. Only equipment that can be adequately supported by the operations layer as specified in condition III.H.1 (e.g., will not have the potential to puncture the liner) shall be used inside of the IDF. All equipment used for construction and operations outside of the IDF shall not damage the berms. Changes to any equipment will follow the process established by condition II.R of the site wide permit. Within 120 days from the effective date is the permit a process for demonstrating compliance with this condition shall be submitted for review by Ecology. This process will be incorporated into appropriate IDF operating procedures prior to IDF operations.

III.11.H.2 The Permittees shall construct berms and ditches to prevent run-on and run-off in accordance with the requirements of Section 4.3.8 of this permit. Before the first placement of waste in the IDF, the Permittees shall submit to Ecology a final grading and topographical map on a scale sufficient to identify berms and ditches used to control run-on and run-off. Upon approval, Ecology will incorporate these maps into the permit as a class 1' modification.

III.11.H.3 The Permittees shall operate the RCRA IDF Cell (Cell1) in accordance with WAC 173-303-665(2) and the operating practices described in Chapters 3, 4, 6, 7, 8 and Appendix 4A, Section 1, subsection 7, except as otherwise specified in this Permit.

III.11.H.4 The Permittees shall maintain a permanent and accurate record of the three-dimensional location of each waste type, based on grid coordinates, within the RCRA IDF Cell (Cell1) in accordance with WAC 173-303-665(5).

III.11.H.5 The Permittees shall inspect the landfill in accordance with WAC 173-303-665(4)(b) and Chapter 6 of this permit, except as otherwise specified in this Permit.

III.11.I WASTE ACCEPTANCE CRITERIA

The only acceptable waste form approved for disposal at the RCRA cell of IDF are IDF operational waste, Immobilized Low Activity Waste (ILAW) in glass form from the Waste Treatment Plant (WTP) Low Activity Waste (LAW) Vitrification facility and ILAW from the Bulk Vitrification Research Demonstration and Development facility (up to 50 boxes). Specifics about waste acceptance criteria for each of these wastes are detailed below.

No other waste forms may be disposed at the RCRA cell of IDF unless authorized via a Permit modification request. Requests for Permit modifications must be accompanied by an analysis adequate for Ecology to comply with SEPA, as well as by a risk assessment and groundwater modeling to show the environmental impact. Permit Condition III.11.I.6 outlines the process by which waste sources in the IDF are modeled in an ongoing risk budget and a ground water impact analysis.

III.11.I.1 Six months prior to IDF operations Permittees shall submit to Ecology for review, approval, and incorporation into the permit, all waste acceptance criteria (WAC) to address, at a minimum, the following: physical/chemical criteria, liquids and liquid containing waste, land disposal restriction treatment standards and prohibitions, compatibility of waste with liner, gas generation, packaging, handling of packages, minimization of subsidence.

III.11.I.1.a All containers/packages shall meet void space requirements pursuant to WAC 173-303-665(12).

III.11.I.1.b Compliance Schedule

III.11.I.1.b.i Six months prior to IDF operations, the Permittees shall submit to Ecology for review, approval, and incorporation into the permit any necessary modifications to the IDF WAP (Appendix 3A of the permit application, DOE/RL-2003-12, Rev 1).

III.11.I.2 ILAW Waste Acceptance Criteria

The only ILAW forms acceptable for disposal at IDF are: (1) approved glass canisters that are produced in accordance with the terms, conditions, and requirements of the WTP portion of the Permit, and (2) the 50 bulk vitrification test boxes as specified in the DBVS test plans.

To assure protection of human health and the environment, it is necessary that the appropriate quality of glass be disposed at IDF. The LDR Treatment Standard for eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver), when associated with High Level Waste is HLVIT (40 CFR 268). Because these metals are constituents in the Hanford Tanks Waste, the LDR standard for ILAW disposed to IDF is HLVIT.

For any ILAW glass form(s) that DOE intends to dispose of in IDF, DOE will provide to Ecology for review, an ILAW Waste Form Technical Requirements Document (IWTRD). The IWTRD will contain:

III.11.I.2.a WTP ILAW Waste Acceptance Criteria

III.11.I.2.a.i A description of each specific glass formulation that DOE intends to use including a basis for why each specific formulation is proposed for use, which specific tank wastes the glass formulation is proposed for use with, the characteristics of the glass that are key to satisfactory performance (e.g., VHT, PCT, and TCLP and/or other approved performance testing methodologies that the parties agree are appropriate and necessary), the range in key characteristics anticipated if the specific glass formulation is produced on a production basis with tank waste, and the factors that DOE must protect against in producing the glass to ensure the intended glass characteristics will exist in the actual ILAW.

III.11.I.2.a.ii A performance assessment that provides a reasonable basis for assurance that each glass formulation will, once disposed of in IDF in combination with the other waste volumes and waste forms planned for disposal at the entire Integrated Disposal Facility, be adequately protective of human health and the environment; and will not violate or be projected to violate all applicable state and federal laws, regulations and environmental standards.

Within 30 days of a request by Ecology, the Permittees shall provide a separate model run using Ecology's assumptions and model input.

III.11.I.2.a.iii A description of production processes including management controls and quality assurance/quality control requirements that assure that glass produced for each formulation will perform in a reasonably similar manner to the waste form assumed in the performance assessment for that formulation.

III.11.I.2.a.iv The Permittees shall update the IWTRD consistent with the above requirements for review by Ecology consistent with their respective roles and authority as provided under the TPA. Ecology comments shall be dispositioned through the Review Comment Record (RCR) process and will be reflected in further modeling to modify the IDF ILAW waste acceptance as appropriate. The initial IWTRD shall be submitted no later than January 2007, or if later than this date, as agreed to by Ecology. At a minimum, the Permittees shall submit updates to the IWTRD to Ecology every five years or more frequently if either of the following conditions exist:

- The Permittees submits a permit modification request allowing additional waste forms to be disposed of at IDF,
- The WTP of other vitrification facility change their glass formulations from those previously included in the ITRWD.

III.11.I.2.a.v The Permittees shall not dispose of any WTP ILAW not described and evaluated in the IWTRD.

III.11.I.3 ILAW Waste Acceptance Criteria Verification

III.11.I.3.a Six months prior to disposing of ILAW in the IDF, the Permittees will submit an ILAW verification plan to Ecology for review and approval. This plan will be coordinated with WTP, Ecology, and the Permittees personnel. This plan will outline the specifics of verifying ILAW waste acceptance through WTP operating parameters, and/or glass sampling. The Plan will include physical sampling requirements for batches, glass formulations, and/or feed envelopes.

III.11.I.4 Demonstration Bulk Vitrification System (DBVS) Bulk Vitrification Waste Acceptance Criteria

III.11.I.4.a Bulk Vitrification waste forms that are acceptable to be disposed of at IDF are up to 50 boxes of vitrified glass produced pursuant to the DBVS RD&D Permit from processing Hanford Tank S-109 tank waste.

III.11.I.4.b If Bulk Vitrification is selected as a technology to supplement the Waste Treatment Plant, the IDF portion of the Permit will need to be modified to accept Bulk Vitrification Full Scale production waste forms. This modification will need to be accompanied by appropriate TPA changes (per M-062 requirements) and adequate risk assessment information sufficient for the Department of Ecology to meet its SEPA obligations.

III.11.I.4.c DBVS Waste Acceptance Verification will occur on 100% of the waste packages. Pursuant to the DBVS RD&D Permit, a detailed campaign test report will be produced and submitted to Ecology detailing results of all testing performed on each waste package that is produced. IDF personnel shall review these reports to verify that the waste packages meet IDF Waste Acceptance Criteria.

III.11.I.4.d The Permittees shall not dispose of any waste forms that do not comply with all appropriate and applicable treatment standards, including all applicable Land Disposal Restrictions (LDR).

III.11.I.5 Modeling – Risk Budget Tool

III.11.I.5.a The Permittees must create and maintain a modeling - risk budget tool, which models the future impacts of the planned IDF waste forms (including input from analysis performed as specified in conditions III.11.I.2.a through III.11.I.2.a.ii above) and their impact to underlying vadose and ground water. This model will be updated at least every 5 years beginning no more than one year after the issuance date of this permit and provided to Ecology for review. The model will be updated more frequently if needed, to support permit modifications or SEPA Threshold Determinations whenever a new waste stream or significant expansion is being proposed for the IDF. This modeling-risk budget tool shall be conducted in manner that is consistent with state and federal requirements, and represents a cumulative risk analysis of all waste previously disposed of in the entire IDF (both cell 1 and cell 2) and those wastes expected to be disposed of in the future for the entire IDF. The groundwater impact should be modeled in a concentration basis and should be compared against various performance standards including but not limited to drinking water standards (40 CFR 141 and 40 CFR 143). Ecology will review modeling assumptions, input parameters, and results and will provide comments to the Permittees. Ecology comments shall be dispositioned through the Review Comment Record (RCR) process and will be reflected in further modeling to modify the IDF ILAW waste acceptance as appropriate.

III.11.I.5.a.i The modeling-risk budget tool will include a sensitivity analysis reflecting parameters and changes to parameters as requested by Ecology.

III.11.I.5.a.ii If these modeling efforts indicate results within 75% of a performance standard [including but not limited to federal drinking water standards (40 CFR 141 and 40 CFR 143)], Ecology and the Permittees will meet to discuss mitigation measures or modified waste acceptance criteria for specific waste forms.

III.11.I.5.a.iii When considering all the waste forms to be disposed of in IDF, the Permittees shall not dispose of any waste that will result (through forward looking modeling or in real groundwater concentrations data) in an violation of any state or federal regulatory limit, specifically including but not limited to drinking water standards for any constituent as defined in 40 CFR 141 and 40 CFR 143.

III.11.I.6 The Permittees shall not dispose of any waste that is not in compliance with state and federal requirements as identified in Chapter 13.0.

III.11.I.6.a In accordance with DOE's authority under the Atomic Energy Act of 1954, as amended and other applicable law, prior to disposing of any mixed immobilized low-activity waste (ILAW) in the IDF, DOE will certify to the State of Washington that it has determined that such ILAW is not high-level waste and meets the criteria and requirements outlined in DOE's consultation with the U.S. Nuclear Regulatory Commission beginning in 1993 (Letter from R.M Bernero, USNRC to J. Lytle, USDOE, dated March 2, 1993; Letter from J Kinzer, USDOE, to C. J, Paperiello, USNRC, Classification of Hanford Low-Activity Tank Waste Fraction, dated March 7, 1996; and Letter from C.J. Paperiello, USNRC, to J. Kinzer, USDOE, Classification of Hanford Low-Activity Tank Waste Fraction, dated June 9, 1997). While the requirement to provide such certification is an enforceable obligation of this permit, the provision of such certification does not convey, or purport to convey, authority to Ecology to regulate the radioactive hazards of the waste under this permit.

III.11.I.7 IDF Operational Waste Acceptance Criteria

IDF operational activities (including decontamination, cleanup, and maintenance) will generate a small amount of waste. Waste that can meet IDF waste acceptance without treatment will be disposed of at the IDF. All other IDF operational waste will be managed pursuant to WAC 173-303-200.

PART IV - UNIT SPECIFIC CONDITIONS FOR CORRECTIVE ACTION

CHAPTER 1

100-NR-1 Operable Unit

The 100-NR-1 Operable Unit (OU) includes solid waste management units and one-time spill sites which are undergoing corrective action. As prescribed by Permit Conditions II.Y of this Permit, this Chapter sets forth the corrective action requirements for the 100-NR-1 OU.

IV.1.A COMPLIANCE WITH APPROVED CORRECTIVE MEASURES STUDY

The Permittees shall comply with all requirements set forth in Attachment 47. Enforceable portions are listed below; all subsections, figures, and tables included in these portions are also enforceable, unless stated otherwise.

ATTACHMENT 47:

Chapter 7.0	Comparative Analysis of Remedial Alternatives
Chapter 9.0, §9.0	Recommended Corrective Measures
Chapter 9.0, §9.1	RCRA Corrective Action Performance Standards
Chapter 9.0, §9.2	Corrective Measures for the 100-NR-1 Operable Unit Source Sites
Chapter 9.0, §9.2.1	Recommended Actions and Justifications
Chapter 9.0, §9.2.2	Cleanup Standards for the 100-NR-1 Operable Unit
Chapter 9.0, §9.2.3	Cost
Chapter 9.0, §9.2.4	Schedule
Chapter 9.0, §9.2.5	Training
Appendix A	Applicable or Relevant and Appropriate Requirements
Appendix G	Cost Estimates

IV.1.B. COMPLIANCE WITH APPROVED ENGINEERING EVALUATION/COST ANALYSIS

The Permittees shall comply with all requirements set forth in Attachment 48. Enforceable portions are listed below; all subsections, figures, and tables included in these potions are also enforceable, unless stated otherwise:

ATTACHMENT 48:

Chapter 2.0, §2.2.1.5	Remedial Unit Five – Description of the SWMU's
Chapter 2.0, Table 2.1	Suspected Contaminants in 100-N Area Ancillary Facilities
Chapter 5.0, §5.2	Compliance with ARARS
Chapter 5.0, §5.10	Other Considerations
Chapter 5.0, Table 5.1	Summary of Estimated Costs for Alternatives Two, Three, and Four
Chapter 6.0	Recommended Alternative
Appendix A	Integration Plan for Decontamination and Demolition and Remedial Action in the 100-N Area

CHAPTER 2

100-NR-2 Operable Unit

The 100-NR-2 Operable Unit (OU) is the ground water below 100-NR-1 OU, which has been contaminated as a result of past intentional disposal operations and unintentional spills of hazardous substances. As prescribed by Permit Conditions II.Y of this Permit, this Chapter sets forth the corrective action requirements for the 100-NR-2 OU.

IV.2.A COMPLIANCE WITH APPROVED CORRECTIVE MEASURES STUDY

The Permittees shall comply with all requirements set forth in Attachment 47. Enforceable portions are listed below; all subsections, figures, and tables included in these portions are also enforceable, unless stated otherwise:

ATTACHMENT 47:

Chapter 7.0	Comparative Analysis of Remedial Alternatives
Chapter 9.0, §9.0	Recommended Corrective Measures
Chapter 9.0, §9.1	RCRA Correction Action Performance Standards
Chapter 9.0, §9.3	Corrective Measure for the 100-NR-2 Operable Unit
Chapter 9.0, §9.3.1	Recommended Action and Justification
Chapter 9.0, §9.3.2	Cleanup Standards for the 100-NR-2 Operable Unit
Chapter 9.0, §9.3.3	Cost
Chapter 9.0, §9.3.4	Schedule
Chapter 9.0, §9.3.5	Training
Appendix A	Applicable or Relevant and Appropriate Requirements
Appendix G	Cost Estimates

IV.2.B. COMPLIANCE WITH APPROVED ENGINEERING EVALUATION/COST ANALYSIS

The Permittees shall comply with all requirements set forth in Attachment 48. Enforceable portions are listed below; all subsections, figures, and tables included in these potions are also enforceable, unless stated otherwise:

ATTACHMENT 48:

Chapter 2.0, §2.2.1.5	Remedial Unit Five – Description of the SWMU's
Chapter 2.0, Table 2.1	Suspected Contaminants in 100-N Area Ancillary Facilities
Chapter 5.0, §5.2	Compliance with ARARS
Chapter 5.0, §5.10	Other Considerations
Chapter 5.0, Table 5.1	Summary of Estimated Costs for Alternatives Two, Three, and Four
Chapter 6.0	Recommended Alternative
Appendix A	Integration Plan for Decontamination and Demolition and Remedial Action in the 100-N Area

PART V - UNIT-SPECIFIC CONDITIONS FOR UNITS UNDERGOING CLOSURE

CHAPTER 1

183-H Solar Evaporation Basins (Superseded by Part VI, Chapter 2)

The 183-H Solar Evaporation Basins (Basins) TSD unit was operated as an evaporation treatment unit for dangerous wastes. The 183-H Solar Evaporation Basins Closure Plan has been completed and clean closure could not be achieved. The Modified Closure Plan presented in Part VI, Chapter 2 supersedes this Chapter.

CHAPTER 2

300 Area Solvent Evaporator (Clean Closed, July 31, 1995)

The 300 Area Solvent Evaporator (300 ASE) unit was operated as an evaporation treatment unit for dangerous wastes. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on July 31, 1995, in accordance with the approved Closure Plan contained in Attachment 16, which was retired during Revision 6 of this Permit.

CHAPTER 3

2727-S Nonradioactive Dangerous Waste Storage Facility (Clean Closed, July 31, 1995)

The 2727-S NRDWSF unit was operated as a storage unit for dangerous wastes. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on July 31, 1995, in accordance with the approved Closure Plan contained in Attachment 17, which was retired during Revision 6 of this Permit.

CHAPTER 4

Simulated High Level Waste Slurry Treatment and Storage Unit (Clean Closed, October 23, 1995)

The Simulated High Level Waste Slurry (SHLWS) unit was operated as a TSD unit for simulated slurry as a test operation in connection with the grout project. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on October 23, 1995, in accordance with the approved Closure Plan contained in Attachment 19, which was retired during Revision 6 of this Permit.

CHAPTER 5

218-E-8 Borrow Pit Demolition Site
(Clean Closed, November 28, 1995)

The 218-E-8 Borrow Pit Demolition Site (218 BPDS) unit was operated as an open burning/open detonation unit for dangerous wastes. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on November 28, 1995, in accordance with the approved Closure Plan contained in Attachment 20, which was retired during Revision 6 of this Permit.

CHAPTER 6

200 West Area Ash Pit Demolition Site
(Clean Closed, November 28, 1995)

The 200 West Area Ash Pit Demolition Site (200 APDS) unit was operated as an open burning/open detonation unit for dangerous wastes. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on November 28, 1995, in accordance with the approved Closure Plan contained in Attachment 21, which was retired during Revision 6 of this Permit.

CHAPTER 7

2101-M Pond
(Clean Closed, November 28, 1995)

The 2101-M Pond unit was operated as a disposal unit for potentially dangerous waste. This chapter sets forth closure requirements for this TSD unit.

This unit was Clean Closed on November 28, 1995, in accordance with the approved Closure Plan contained in Attachment 22, which was retired during Revision 6 of this Permit.

CHAPTER 8

216-B-3 Expansion Ponds
(Clean Closed, July 31, 1995)

The 216-B-3 Expansion Ponds unit was operated as a treatment and disposal unit for dangerous waste. This chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on July 31, 1995, in accordance with the approved Closure Plan contained in Attachment 23, which was retired during Revision 6 of this Permit.

CHAPTER 9

Hanford Patrol Academy Demolition Site
(Clean Closed, November 28, 1995)

The Hanford Patrol Academy Demolition Site (HPADS) unit was operated as an open burning/open detonation unit for dangerous waste. This Chapter sets forth the closure requirements for this TSD unit.

This unit was Clean Closed on November 28, 1995, in accordance with the approved Closure Plan contained in Attachment 24, which was retired during Revision 6 of this Permit.

CHAPTER 10

105-DR Large Sodium Fire Facility
(Partial Closure Plan Completed, October 1, 1996)

The Large Sodium Fire Facility (LSFF) was a research laboratory used to conduct experiments for studying the behavior of alkali metals. This facility was also used for the treatment of alkali metal dangerous wastes.

This unit completed the closure plan on October 1, 1996, in accordance with the approved Closure Plan contained in Attachment 25, which was retired during Revision 6 of this Permit.

CHAPTER 11

304 Concretion Facility
(Clean Closed, January 21, 1996)

The 304 Concretion Facility (304 Facility) was used for the treatment of dangerous wastes produced during the fuel fabrication process. These wastes consist of beryllium/Zircalloy-2 chips and Zircalloy-2 chips and fines.

This Unit was Clean Closed on January 21, 1996, in accordance with the approved Closure Plan contained in Attachment 26, which was retired during Revision 6 of this Permit.

CHAPTER 12

4843 Alkali Metal Storage Facility Closure Plan
(Clean Closed, April 14, 1997)

The 4843 Alkali Metal Storage Facility (4843 AMSF) is an inactive storage facility which is currently undergoing permanent closure activities. This TSD unit was operated as a storage unit for dangerous waste and alkali metals.

This unit was clean closed on April 14, 1997, in accordance with the approved closure plan contained in Attachment 29, which was retired during Revision 6 of this Permit.

CHAPTER 13

3718-F Alkali Metal Treatment and Storage Facility Closure Plan
(Clean Closed, August 4, 1998)

The 3718-F Alkali Metal Treatment and Storage Facility was operated to treat and store alkali metal waste from the Fast Flux Test Facility, and from various laboratories that used alkali metals for experiments. Contaminated equipment was treated using water, methanol, isopropyl alcohol, or 2-butoxy ethanol. Bulk waste was treated by burning to eliminate the ignitability and reactive characteristics. After the burn treatment, the waste was neutralized with acid to a pH between 2 and 12.5.

This unit was Clean Closed on August 4, 1998, in accordance with the approved Closure Plan contained in Attachment 30, which was retired during Revision 6 of this Permit.

CHAPTER 14

303-K Storage Facility (Clean Closed July 22, 2002)

The 303-K Storage Facility (303-K) was used for storage of mixed waste produced during the fuel fabrication process. These wastes consisted of beryllium/zircalloy-2 chips which were concreted at the 304 Concretion Facility, and other process wastes.

This unit was Clean Closed on July 22, 2002, in accordance with the approved Closure Plan contained in Attachment 32, which was retired during Revision 6 of this Permit.

CHAPTER 15

100 D Ponds
(Clean Closed, August 9, 1999)

The 100 D Ponds was operated as a liquid effluent disposal site for dangerous wastes. This unit was Clean Closed on August 9, 1999, in accordance with the approved Clean Closure Plan contained in Attachment 40, which was retired during Revision 6 of this Permit.

CHAPTER 16

1325-N Liquid Waste Disposal Facility

The 1325-N Liquid Waste Disposal Facility (LWDF) is an inactive TSD unit that is currently undergoing modified closure activities. This TSD unit was operated as a liquid waste disposal facility for dangerous wastes.

This Chapter sets forth the modified closure requirements for the 1325-N LWDF.

V.16.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in the Hanford Facility Dangerous Waste Permit, as specified in Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 1325-N LWDF, including all modifications.

In the event that the Part V – Unit-Specific Conditions for 1325-N LWDF conflict with the Part I - Standard Conditions and/or Part II – General Facility Conditions of the Permit the unit-specific conditions for 1325-N LWDF prevail.

1325-N LIQUID WASTE DISPOSAL FACILITY, ATTACHMENT 41:

Chapter 1.0	Part A Dangerous Waste Permit, from Class 1 modification dated September 30, 2005 1325-N Liquid Waste Disposal Facility Revision 8
Chapter 2.0	Unit Description, from Class 1 modification dated August 2004
Chapter 3.0	Groundwater Monitoring, from Class 1 modification dated August 2004
Chapter 4.0	Closure Activities, from Class 1 modification dated March 31, 2005
Chapter 5.0	Postclosure Plan, from Class 1 modification dated August 2004

CHAPTER 17

1301-N Liquid Waste Disposal Facility

The 1301-N Liquid Waste Disposal Facility is an inactive TSD unit that is currently undergoing modified closure activities. This TSD unit was operated as a liquid waste disposal facility for dangerous waste. This Chapter sets forth the modified closure requirements for this TSD unit.

V.17.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in the Hanford Facility Dangerous Waste Permit, as specified in Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 1301-N LWDF,, including all modifications.

In the event that the Part V – Unit-Specific Conditions for 1301-N LWDF conflict with the Part I - Standard Conditions and/or Part II – General Facility Conditions of the Permit the unit-specific conditions for 1301-N LWDF prevail.

1301-N LIQUID WASTE DISPOSAL FACILITY, ATTACHMENT 41:

Chapter 1.0	Part A Dangerous Waste Permit, from Class 1 modification dated September 30, 2005 1301-N Liquid Waste Disposal Facility, Revision 8
Chapter 2.0	Unit Description, from Class 1 modification dated August 2004
Chapter 3.0	Groundwater Monitoring, from Class 1 modification dated August 2004
Chapter 4.0	Closure Activities, from Class 1 modification dated March 31, 2005
Chapter 5.0	Postclosure Plan, from Class 1 modification dated August 2004

CHAPTER 18

1324-N Surface Impoundment

The 1324-N Surface Impoundment was a TSD unit that operated as a percolation unit for dangerous wastes. This unit completed their Closure Plan.

V.18.A. COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Hanford Facility Dangerous Waste Permit, as specified in Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 1324-N Surface Impoundment , including all modifications.

In the event that the Part V – Unit-Specific Conditions for 1324-N Surface Impoundment conflict with the Part I – Standard Conditions and/or Part II – General Facility Conditions of the Permit the unit-specific conditions for 1324-N Surface Impoundment prevail.

1324-N SURFACE IMPOUNDMENT, ATTACHMENT 42:

Chapter 1.0	Part A, Dangerous Waste Permit, from Class 1 modification dated September 30, 2005 1324-N Surface Impoundment, Revision 4
Chapter 2.0	Unit Description, from Class 1 modification dated August 2004
Chapter 3.0	Ground Water Monitoring, from Class 1 modification dated August 2004
Chapter 4.0	Closure, from Class 1 modification dated August 2004
Chapter 5.0	Post-Closure Plan, from Class 1 modification dated August 2004

CHAPTER 19

1324-NA Percolation Pond

The 1324-NA Percolation Pond is an inactive TSD unit that is currently undergoing modified closure activities. This TSD unit was operated as a surface impoundment unit for dangerous wastes. This Chapter sets forth the modified closure requirements for this TSD unit.

V.19.A. COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Hanford Facility Dangerous Waste Permit, as specified in Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 1324-NA Percolation Pond, including all modifications.

In the event that the Part V – Unit-Specific Conditions for 1324-N Surface Impoundment conflict with the Part I – Standard Conditions and/or Part II – General Facility Conditions of the Permit the unit-specific conditions for 1324-NA Percolation Pond prevail.

1324-NA PERCOLATION POND, ATTACHMENT 42:

Chapter 1.0	Part A, Dangerous Waste Permit, from Class 1 modification dated September 30, 2005 1324-NA Percolation Pond, Revision 4
Chapter 2.0	Unit Description, from Class 1 modification dated August 2004
Chapter 3.0	Ground Water Monitoring, from Class 1 modification dated August 2004
Chapter 4.0	Closure, from Class 1 modification dated August 2004
Chapter 5.0	Post-Closure Plan, from Class 1 modification dated August 2004

CHAPTER 20

300 Area Waste Acid Treatment System

(Partial Closure Plan Completed, December 3, 2001)

The 300 Area Waste Acid Treatment System (300 WATS) was a tank system that was used to treat and store nonrecoverable uranium-bearing waste acid from reactor fuel fabrication operations. Waste acid neutralization occurred in portions of what now is the 300 Area WATS before operation of the system as a *Resource Conservation and Recovery Act* (RCRA) *of 1976* unit. The Closure Plan detailed closure of 300 Area WATS components, areas, and contamination resulting from RCRA operations. This unit consisted of portions of four (4) buildings and two (2) tank farms: 334-A Building, 313 Building, 303-F Building, 333 Building, 334 (tank 4), and 311 Tank Farms (tanks 40 and 50).

Closure activities were completed in September 1999, in accordance with the approved Closure Plan contained in Attachment 46 that was retired during Revision 6 of this Permit. Clean closure was given for structures above the ground using the visually verifiable 'clean debris surface' rule and table in the *Ecology Guidance for Clean Closure of Dangerous Waste Facilities Publication #94-111* (August, 1994). The disposition of unclosed 300 Area WATS soils will be performed in conjunction with the 300-FF-2 CERCLA OU remedial action to complete WATS RCRA closure.

V.20.A COMPLIANCE

The Permittees shall comply with all requirements set forth in the Hanford Facility Dangerous Waste Permit, as specified in Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 300 Area WATS, including all approved modifications.

In the event that these Part V – Unit-Specific Conditions conflict with the Part I – Standard Conditions and/or Part II – General Facility Conditions of the Permit the unit-specific conditions for 300 Area WATS prevail.

300 AREA WATS:

Chapter 1.0 Part A, Dangerous Waste Permit, Revision, 7, dated July 2005

V.20.B. UNIT-SPECIFIC CONDITIONS FOR 300 AREA WATS:

V.20.B.1 Soil Contamination Areas 1 and 2, identified in the Part A, shall be inspected annually to ensure that the contamination at these locations remains immobilized until final disposition. Soil over the concrete block covers of 300 Area WATS and U-Bearing Piping Trench that covers Soil Contamination Area 1 will be inspected annually for disturbance indicating a potential for contamination at this area to become mobilized. The concrete slab surface over Soil contamination Area 2, located inside the 313 Building, will be inspected annually for cracks or major degradation and the presence of water that could mobilize soil contamination at this location. If unsatisfactory conditions are identified during annual inspections, Ecology will be notified for discussion of an appropriate response. This condition constitutes the TSD unit's inspection schedule.

V.20.B.2 A contingency plan, personnel training plan, or a waste analysis plan will not be required for the 300 Area WATS following partial closure, as this scope of work is included in the 300-FF-2 remedial action.

PART VI - UNIT-SPECIFIC CONDITIONS FOR UNITS IN POST-CLOSURE

CHAPTER 1

300 Area Process Trenches

The 300 Area Process Trenches were operated to receive effluent discharges of dangerous mixed waste from fuel fabrication laboratories in the 300 Area. This chapter sets forth the modified closure requirements.

VI.1.A. COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Attachment 31, including Permit Conditions specified in VI.1.B. The Permittees shall also comply with all the requirements in the 300-FF-1 and 300-FF-5 Record of Decision. All sections, figures, and tables included in these portions are enforceable:

ATTACHMENT 31:

Chapter 1.0	Part A Dangerous Waste Permit, Revision 6, from Class 1 modification dated May 2005
Chapter 2.0	Introduction, from Class 1 modification dated June 30, 2002
Chapter 3.0	300 Area Process Trenches Groundwater Monitoring Plan, RCRA Final Status Compliance Monitoring Plan (i.e., WHC-SD-EN-AP-185), dated June 30, 2002
Chapter 4.0	Closure Contact, from Class 1 Modification dated February 2004
Chapter 5.0	Certification of Postclosure, from Class 1 Modification dated February 2004
Chapter 8.0	Postclosure, from Class 1 modification dated June 30, 2002

VI.1.B. AMENDMENTS TO THE APPROVED MODIFIED CLOSURE PLAN

VI.1.B.1. Pursuant to Permit Condition II.K.7, the 300 Area Process Trenches (APT) closure shall be a Modified Closure in coordination with the Record of Decision (ROD) for 300-FF-1 and 300-FF-5. Sections of CERCLA documents (examples may include, but are not limited to, Remedial Design/Remedial Action CERCLA work plan, the Operation and Monitoring Work Plan, etc.), which satisfy requirements and Conditions of this Modified Closure Plan, will be reviewed and approved by Ecology.

VI.1.B.2. As stipulated through Attachment 31, Chapter 3.0 the RCRA Final Status Compliance Monitoring Plan (i.e., WHC-SD-EN-AP-185) Appendix IX, sampling shall not be required unless post-closure monitoring results indicate a need to do so.

CHAPTER 2

183-H Solar Evaporation Basins

The 183-H Solar Evaporation Basins comprise an inactive TSD unit that is undergoing postclosure activities. This TSD unit was operated as an evaporation treatment unit for dangerous wastes.

VI.2.A. COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Attachment 37, including Permit Conditions specified in VI.2.B. All sections, figures, and tables included in these portions are enforceable:

ATTACHMENT 37:

Chapter 1.0 Part A Dangerous Waste Permit, Revision 6, from Class 1 modification dated May 2005

Chapter 2.0 Modified Postclosure Institutional Controls and Periodic Assessments, from Class 1 modification dated June 30, 2002

Chapter 3.0 Ground Water Monitoring During Postclosure, from Class 1 modification dated June 30, 2002

Chapter 4.0 Corrective Action Plan, from Class 1 modification dated June 30, 2002

Chapter 5.0 Personnel Training During Postclosure, from Class 1 modification dated June 30, 2002

Chapter 6.0 Security, from Class 1 modification dated February 2004

Chapter 7.0 Closure Contact, from Class 1 modification dated February 2004

Chapter 8.0 Certification of Postclosure, from Class 1 modification dated June 30, 2002

VI.2.B. AMENDMENTS TO THE APPROVED POST-CLOSURE PLAN

VI.2.B.1. The Permittee will review the modified closure option in five (5) years (February 28, 2008). The purpose of the review will be to determine if this TSD unit can be clean closed.

VI.2.B.2. Well 199-H4-7, is removed from the ground water monitoring network identified in Chapter 3.0 and replaced with well 199-H4-8.

ATTACHMENT 52

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

This document can be found on pages 265-275 in the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion Revision 8.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 1.0 **Part A**

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1.0 PART A INTRODUCTION

Revision 0, of the Part A, Form 3, included with this permit application, constitutes the initial submittal to the Washington State Department of Ecology (Ecology). The Notice of Intent (NOI), associated with this unit, was filed with Ecology in November 2001.

Revision 1, of the Part A, Form 3, was updated to submit with the Revision 1, of the Part B permit application. The Part B permit application was submitted February 2004.

Revision 2, of the Part A Form was updated to the new Ecology Part A application format effective January 1 2005, and to reflect the decision to limit the acceptable IDF mixed waste streams. Revision 2 was submitted February 2005.

Revision 3, of the Part A Form was updated to clarify the total combined ILAW and Bulk Vitrification waste volumes to be accepted at IDF. Revision 3 was submitted March 2005

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Dangerous Waste Permit Application
Part A Form

Date Received	Reviewed by:	Date:
Month Day Year	Approved by:	Date:
	Please refer to instructions for completing this form.	

I. This form is submitted to: (place an "X" in the appropriate box)

☐	Request modification to a final status permit (commonly called a "Part B" permit)
☐	Request a change under interim status
☒	Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).
☐	Establish interim status because of the wastes newly regulated on: (Date)
	List waste codes:

II. EPA/State ID Number

W	A	7	8	9	0	0	0	8	9	6	7

III. Name of Facility

US Department of Energy – Hanford Facility

IV. Facility Location (Physical address not P.O. Box or Route Number)

A. Street

825 Jadwin

City or Town	State	ZIP Code
Richland	WA	99352

County Code (if known)	County Name
0 0 5	Benton

B. Land Type	C. Geographic Location Latitude (degrees, mins, secs)	Longitude (degrees, mins, secs)	D. Facility Existence Date Month	Day	Year
F	S E E T O P O	M A P	0 3	0 2	1 9 4 3

V. Facility Mailing Address

Street or P.O. Box

P.O. Box 550

City or Town	State	ZIP Code
Richland	WA	99352

VI. Facility contact (Person to be contacted regarding waste activities at facility)		
Name (last)	**(first)**	
Schepens	Roy	
Job Title	**Phone Number (area code and number)**	
Manager	(509) 376-6677	
Contact Address		
Street or P.O. Box		
P.O. Box 450		
City or Town	**State**	**ZIP Code**
Richland	WA	99352

VII. Facility Operator Information		
A. Name	**Phone Number (area code and number)**	
Department of Energy * Owner/Operator CH2MHill Hanford Group, Inc.** Co-Operator for Integrated Disposal Facility	(509) 376-6677* / (509) 376-7395* (509) 373-1677 **	
Street or P.O. Box		
P.O. Box 450 * P.O. Box 1500 **		
City or Town	**State**	**ZIP Code**
Richland	WA	99352
B. Operator Type	F	
C. Does the name in VII.A reflect a proposed change in operator?	☐ Yes ☒ No	
If yes, provide the scheduled date for the change:	Month / Day / Year	
D. Is the name listed in VII.A. also the owner? If yes, skip to Section VIII.C.	☐ Yes ☒ No	

VIII. Facility Owner Information		
A. Name	**Phone Number (area code and number)**	
Keith A. Klein, Operator/Facility-Property Owner Roy J. Schepens, Operator/Facility-Property Owner*	(509) 376-7395 / (509) 376-6677*	
Street or P.O. Box		
P.O. Box 550		
City or Town	**State**	**ZIP Code**
Richland	WA	99352
B. Operator Type	F	
C. Does the name in VII.A reflect a proposed change in operator?	☐ Yes ☒ No	
If yes, provide the scheduled date for the change:	Month / Day / Year	

IX. NAICS Codes (5/6 digit codes)														
A. First							**B. Second**							
5	6	2	2	1		Waste Treatment & Disposal	9	2	4	1	1		Administration of Air & Water Resource & Solid Waste Management Programs	
C. Third							**D. Fourth**							

5	4	1	7	1		Research & Development in the Physical, Engineering, & Life Sciences	9	9	9	9	9	9	Unclassified Establishments

X. Other Environmental Permits (see instructions)

A. Permit Type	B. Permit Number	C. Description
E		Non-Rad NOC for operation (in development)
E		Rad NOC for operation (in development)
E	MBL-6013192 3	Master Business License
E		
E		
E		
E		

XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)

Mixed waste disposed at the IDF will be limited to vitrified low-activity waste (LAW) from the RPP-WTP and Demonstration Bulk Vitrification System (DBVS). Additionally, mixed waste generated by IDF operations will be disposed of in IDF. Vitrified LAW generated by RPP-WTP is known as Immobilized Low Activity Waste (ILAW) and generated by DBVS is known as Bulk Vitrified Waste (BVW). The "Amount" shown in Section XII of 8.2 hectare meters (82,000 cubic meters) is the waste capactiy of the initial construction. The "Amount" will be revised as required for future expansion to accommodate the entire waste volume through an approved permit modification.

D80

For the ILAW and BVW that will be in steel canisters or boxes, the characteristic dangerous waste numbers D002, and D004 through D011 that are associated with waste stored in the Double-Shell and Single-Shell Tank System, are listed but anticipated to be treated by the specified technology based treatment standard for high-level radioactive waste as described in 40 Code of Federal Regulations (CFR) 268.40 (vitrification). Tank waste will meet this standard as the waste exits at the Waste Treatment Plant or Demonstration Bulk Vitrification System process. All the dangerous waste numbers are associated with the mixed waste that will be disposed within the Integrated Disposal Facility.

IDF operational activities (including decontamination, cleanup and maintenance) will generate a small amount of waste. Waste that can meet IDF waste acceptance without treatment will be buried at the IDF. All other IDF operational waste will be managed pursuant to WAC 173-303-200 and either sent to a 90 day accumulation area or directly to another permitted TSD for treatment. Treated IDF operational waste will either be buried at IDF or sent to another permitted Hanford TSD for final disposition.

S01

Process Code S01 (container storage) has been included within this Part A, Form in the event that storage is required before final disposal (e.g., to support the staging and confirmation process of the waste or cooling of vitrified waste if required).

EXAMPLE FOR COMPLETING ITEMS XII and XIII (shown in lines numbered X-1, X-2, and X-3 below): A facility has two storage tanks that hold 1200 gallons and 400 gallons respectively. There is also treatment in tanks at 20 gallons/hr. Finally, a one-quarter acre area that is two meters deep will undergo *in situ vitrification.*

Section XII. Process Codes and Design Capacities					Section XIII. Other Process Codes					
Line Number	A. Process Codes (enter code)	B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure (enter code)	C. Process Total Number of Units	Line Number	A. Process Codes (enter code)	B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure (enter code)	C. Process Total Number of Units	D. Process Description
X 1	S 0 2	1,600	G	002	X 1	T 0 4	700	C	001	In situ vitrification
X 2	T 0 3	20	E	001						
X 3	T 0 4	700	C	001						
1	D 8 0	8.2	F	1	1					
2	S 0 1	*	*	1	2					
3					3					
4					4					
5					5					
6					6					
7					7					
8					8					
9					9					
1 0					1 0					
1 1					1 1					
1 2					1 2					
1 3					1 3					
1 4					1 4					
1 5					1 5					
1 6					1 6					
1 7					1 7					
1 8					1 8					
1 9					1 9					
2 0					2 0					
2 1					2 1					
2 2					2 2					
2 3					2 3					
2 4					2 4					
2 5					2 5					

XIV. Description of Dangerous Wastes

Example for completing this section: A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Processes: (1) Process Codes (enter)	D. Processes: (2) Process Description [If a code is not entered in D (1)]
X 1	D 0 0 2	400	P	S 0 1 T 0 1	
X 2	D 0 0 1	100	P	S 0 2 T 0 1	
X 3	D 0 0 2				Included with above
1	D 0 0 1	20,000,000	K	D 8 0	Disposal
2	D 0 0 2		K	D 8 0	Disposal
3	D 0 0 3		K	D 8 0	Disposal
4	D 0 0 4		K	D 8 0	Disposal
5	D 0 0 5		K	D 8 0	Disposal
6	D 0 0 6		K	D 8 0	Disposal
7	D 0 0 7		K	D 8 0	Disposal
8	D 0 0 8		K	D 8 0	Disposal
9	D 0 0 9		K	D 8 0	Disposal
1 0	D 0 1 0		K	D 8 0	Disposal
1 1	D 0 1 1		K	D 8 0	Disposal
1 2	D 0 1 8		K	D 8 0	Disposal
1 3	D 0 1 9		K	D 8 0	Disposal
1 4	D 0 2 2		K	D 8 0	Disposal
1 5	D 0 2 8		K	D 8 0	Disposal
1 6	D 0 2 9		K	D 8 0	Disposal
1 7	D 0 3 0		K	D 8 0	Disposal
1 8	D 0 3 3		K	D 8 0	Disposal
1 9	D 0 3 4		K	D 8 0	Disposal
2 0	D 0 3 5		K	D 8 0	Disposal
2 1	D 0 3 6		K	D 8 0	Disposal
2 2	D 0 3 8		K	D 8 0	Disposal
2 3	D 0 3 9		K	D 8 0	Disposal
2 4	D 0 4 0		K	D 8 0	Disposal
2 5	D 0 4 1		K	D 8 0	Disposal

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process (1) Process Codes (enter)	D. Process (2) Process Description [If a code is not entered in D (1)]
2 6	D 0 4 3		K	D 8 0	Disposal
2 7	W T 0 1		K	D 8 0	Disposal
2 8	W T 0 2		K	D 8 0	Disposal
2 9	W P 0 1		K	D 8 0	Disposal
3 0	W P 0 2		K	D 8 0	Disposal
3 1	F 0 0 1		K	D 8 0	Disposal
3 2	F 0 0 2		K	D 8 0	Disposal
3 3	F 0 0 3		K	D 8 0	Disposal
3 4	F 0 0 4		K	D 8 0	Disposal
3 5	F 0 0 5		K	D 8 0	Disposal
3 6	F 0 3 9		K	D 8 0	Disposal
3 7	D 0 0 1	600,000	K	S 0 1*	Container Storage
3 8	D 0 0 2		K	S 0 1*	Container Storage
3 9	D 0 0 3		K	S 0 1*	Container Storage
4 0	D 0 0 4		K	S 0 1*	Container Storage
4 1	D 0 0 5		K	S 0 1*	Container Storage
4 2	D 0 0 6		K	S 0 1*	Container Storage
4 3	D 0 0 7		K	S 0 1*	Container Storage
4 4	D 0 0 8		K	S 0 1*	Container Storage
4 5	D 0 0 9		K	S 0 1*	Container Storage
4 6	D 0 1 0		K	S 0 1*	Container Storage
4 7	D 0 1 1		K	S 0 1*	Container Storage
4 8	D 0 1 8		K	S 0 1*	Container Storage
4 9	D 0 1 9		K	S 0 1*	Container Storage
5 0	D 0 2 2		K	S 0 1*	Container Storage
5 1	D 0 2 8		K	S 0 1*	Container Storage
5 2	D 0 2 9		K	S 0 1*	Container Storage
5 3	D 0 3 0		K	S 0 1*	Container Storage
5 4	D 0 3 3		K	S 0 1*	Container Storage
5 5	D 0 3 4		K	S 0 1*	Container Storage
5 6	D 0 3 5		K	S 0 1*	Container Storage
5 7	D 0 3 6		K	S 0 1*	Container Storage
5 8	D 0 3 8		K	S 0 1*	Container Storage
5 9	D 0 3 9		K	S 0 1*	Container Storage

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process (1) Process Codes (enter)	D. Process (2) Process Description [If a code is not entered in D (1)]
60	D040		K	S01*	Container Storage
61	D041		K	S01*	Container Storage
62	D043		K	S01*	Container Storage
63	WT01		K	S01*	Container Storage
64	WT02		K	S01*	Container Storage
65	WP01		K	S01*	Container Storage
66	WP02		K	S01*	Container Storage
67	F001		K	S01*	Container Storage
68	F002		K	S01*	Container Storage
69	F003		K	S01*	Container Storage
70	F004		K	S01*	Container Storage
71	F005		K	S01*	Container Storage
72	F039		K	S01*	Container Storage
73					
74					
75					
76					
77					
78					
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XV. Map

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (refer to Instructions for more detail).

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to Instructions for more detail).

XVIII. Certifications

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Operator* Name and Official Title (type or print) Roy J. Schepens, Manager U.S. Department of Energy Office of River Protection	**Signature**	**Date Signed**
Co-Operator** Name and Official Title (type or print) Edward S. Aromi President and Chief Executive Officer CH2MHill Hanford Group, Inc.	**Signature**	**Date Signed**
Co-Operator** – Address and Telephone Number 2440 Stevens Center P.O. Box 1500 Richland, WA 99352 (509) 373-1677		
Facility-Property Owner* Name and Official Title (type or print) Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office	**Signature**	**Date Signed**

Comments

Integrated Disposal Facility

This section has been identified as
"Official Use Only" (OUO)
and is available to view by appointment at
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

Integrated Disposal Facility, 200 East Area Locational References

Integrated Disposal Facility

IDF Topographic Map (Refer to Appendix 2A)

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 2.0 Topographic Map Description

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2.0 TOPOGRAPHIC MAP DESCRIPTION

2.1 Introduction

A topographic map is located in Appendix 2A reflecting general topographic requirements and the area set aside for IDF. The actual dimensions and waste volume capacity of the RCRA trench that is being permitted are described in the Part A and Section 2.1 of the permit application. The IDF is located on the Hanford Facility, which limits the use of surrounding land to Department of Energy activities. There are no surface waters in the area defined on the topographical map. Chapter 5.0 includes figures that reflect additional requirements for topographic maps. For the point of compliance and proposed groundwater wells see Figure 5-8, and for the aquifer location see Figure 5-4 and Section 5.3 for the identification of the aquifer.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS
OPERATING UNIT 11

Integrated Disposal Facility

Appendix 2A **Topographic Map**

OFFFICIAL USE ONLY

This section has been identified as
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and is available to view by appointment at
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Richland, Washington.

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for a viewing appointment.

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS
OPERATING UNIT 11

Integrated Disposal Facility

Chapter 3.0 **Waste Analysis Plan**

Figures

Tables

WASTE ANALYSIS [C]

This chapter provides information on the chemical, biological, and physical characteristics of the waste treated for disposal. The information includes descriptions required by WAC 173-303-300(5) contained in the *Waste Analysis Plan for the Integrated Disposal Facility*.

CHEMICAL, BIOLOGICAL, AND PHYSICAL ANALYSIS [C-1]

The primary mission of the IDF will be to dispose of vitrified waste generated on the Hanford Site. This includes vitrified LAW from the RPP-WTP and DBVS, and low-level radioactive waste. Additionally, waste generated through IDF operations will be disposed of in IDF. Waste to be disposed of in IDF is assigned dangerous waste numbers found in Chapter 1.0.

WASTE ANALYSIS PLAN [C-2]

The *Waste Analysis Plan for the Integrated Disposal Facility* summarizes waste acceptance processes and contains the following information: unit description, confirmation process, selection of waste analysis parameters, selection of sampling procedures, selection of a laboratory, laboratory testing, and analytical methods, selection of waste re-evaluation frequencies, special procedural requirements, and recordkeeping requirements.

GLOSSARY

AEA	Atomic Energy Act of 1954
BVW	bulk vitrification waste
CAP	corrective action plan
CFR	Code of Federal Regulations
COLIWASA	composite liquid waste sampler
°C	degree Celsius
DOE-ORP	U.S. Department of Energy, Office of River Protection
DOE-RL	U.S. Department of Energy, Richland Operations Office
DBVS	Demonstration Bulk Vitrification System
DST	double-shell tank
Ecology	Washington State Department of Ecology
IDF	Integrated Disposal Facility
ILAW	immobilized low-activity waste
LDR	land disposal restriction
NDE	nondestructive examination
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	Revised Code of Washington
RPP-WTP	River Protection Project-Waste Treatment Plant
SWITS	Solid Waste Information Tracking System
TRU	transuranic
TSCA	*Toxic Substances Control Act of 1976*
TSD	treatment, storage, and/or disposal
WAC	Washington Administrative Code
WAP	waste analysis plan

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
	Length			**Length**	
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
	Area			**Area**	
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
	Mass (weight)			**Mass (weight)**	
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	Tons (metric)	1.1023	tons (short)
	Volume			**Volume**	
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
	Temperature			**Temperature**	
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
	Energy			**Energy**	
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
	Force/Pressure			**Force/Pressure**	
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1993, Professional Publications, Inc., Belmont, California.

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3.0 INTEGRATED DISPOSAL FACILITY WASTE ANALYSIS PLAN

Pursuant to WAC 173-303-300(5) this waste analysis plan (WAP) documents the waste acceptance process, sampling methodologies, analytical techniques, and overall processes that will be undertaken for mixed waste accepted for disposal at the Integrated Disposal Facility (IDF). . Mixed waste disposed at the IDF will be limited to vitrified low-activity waste (LAW) from the RPP-WTP and DBVS and mixed waste generated by IDF operations. (see Chapter 1, Part A Form). Vitrified LAW generated by RPP-WTP is known as Immobilized Low Activity Waste (ILAW) and generated by DBVS is known as Bulk Vitrified Waste (BVW). The IDF will be located in the 200 East Area of the Hanford Facility.

The IDF also will receive low-level waste for disposal. Mixed waste will not be placed in the low-level waste portion of the IDF. The requirements of this WAP are applicable to mixed waste and are not applicable to the low-level radioactive waste. The term 'treatment, storage, and/or disposal (TSD) unit' is used throughout this WAP to refer to the IDF. Activities will be performed by the IDF operating organization, waste acceptance organization, or its delegated representative.

Although the treatment and disposal of radioactive waste (i.e., source, special nuclear, and by-product materials as defined by the *Atomic Energy Act of 1954*) are not within the scope of *Resource Conservation and Recovery Act* (RCRA) *of 1976* or WAC 173-303, information is provided for general knowledge.

3.1 DESCRIPTION OF UNIT PROCESSES AND ACTIVITIES

The IDF will be a single, expandable disposal facility constructed to RCRA Subtitle C standards, half of which is for disposal of mixed waste the other half will be for disposal of low-level waste. Initial capacity for mixed waste disposal is 82,000 cubic meters of waste with an ultimate capacity of up to 450,000 cubic meters of waste. Disposal capacity beyond the initial 82,000 cubic meters will require a modification to the Part B Permit. The mixed waste types to be disposed in the IDF include vitrified LAW from the RPP-WTP and DBVS. Additionally, mixed waste generated by IDF operations will be disposed of in IDF.

The mission of the RCRA portion of the IDF is to provide an approved disposal facility for the permanent, environmentally safe disposition of mixed waste and RCRA waste.

For ILAW, and BVW the container packaging and handling will be designed to maintain containment of each waste type, limit intrusion, and limit human exposure at the IDF. ILAW containers will be transported from the RPP-WTP to the IDF using a tractor-trailer system. BVW will be transported from the DBVS staging area to IDF using a similar system. Transport of the ILAW and BVW to the landfill will occur along a pre-determined route.

The lined landfill will have a leachate collection and removal system. The leachate collection tanks will be operated in accordance with the generator provisions of WAC 173-303-200 and are not subject to this WAP.

Additional information is located in Chapter 1.0 (IDF Part A), Chapter 2.0 (Facility Description), and Chapter 4.0 (Process Information).

3.2 IDENTIFICATION AND CLASSIFICATION OF WASTE

The ILAW, BVW, and newly generated mixed waste will be accepted for disposal. The mixed waste disposed of at the IDF is received from waste generated within IDF, and two other Hanford Facility TSD units (RPP-WTP and DBVS). The following waste will not be accepted for disposal at this TSD unit:

- Waste is not accepted for disposal when the waste contains free-standing liquid unless all free-standing liquid:
  - Has been removed by decanting or other methods
  - Has been mixed with sorbent or stabilized (solidified) so that free-standing liquid is no longer observed
  - Otherwise has been eliminated
  - Container is very small, such as an ampoule
  - Container is a labpack and is disposed in accordance with WAC 173-303-161 or 40 Code of Federal Regulations (CFR) 264.316
  - Container is designed to hold free liquids for use other than storage, such as a battery or capacitor.

  There could be cases in which small amounts of residual liquids are present in mixed waste containers because condensate has formed following packaging or free liquids remain in debris items (e.g., pumps, tubing) even after draining. When it is not practical to remove this residual liquid, the free liquid must be eliminated to the extent possible by adding a quantity of sorbent sufficient to sorb all residual liquids.

  Free liquid is determined by SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Method*, Method 9095 (Paint Filter Liquids Test) [WAC 173-303-140(4)(b) and 40 CFR 264.314(d)] only for waste that has the potential for free liquid formation.

- Gaseous waste not accepted for disposal if the is waste packaged at a pressure in excess of 1.5 atmospheres at 20°C
- Pyrophoric waste is not accepted for disposal. Waste containing less that 1 weight percent pyrophoric material partially or completely dispersed in each package is not considered pyrophoric for the purposes of this requirement.
- Solid acid waste is not accepted for disposal [WAC 173-303-140 (4)(c)]
- Extremely hazardous waste that does not meet WAC 173-303-140(4)(d) is not accepted for disposal. Extremely hazardous waste that has been treated could be disposed in accordance with Revised Code of Washington (RCW) 70.105.050(2), "Hazardous Waste Management"
- Organic/carbonaceous waste that does not meet WAC 173-303-140(4)(d) is not accepted for disposal
- Waste not meeting the LDR treatment standards is not accepted for disposal [40 CFR 268 and WAC 173-303-140(4)]
- Waste streams will be evaluated during pre-shipment review to ensure that the waste streams do not contain constituents incompatible with the liner system in concentration sufficient to degrade the liner. Table 1 provides a list of chemicals shown to be incompatible with the liner material at 100% concentrations (WHC-SD-WM-TI-714). In general, mixed waste that meets federal and state treatment standards would be compatible with the TSD unit liner system. Waste accepted at the IDF will be compatible with the liner. Constituents in Table 1 will not be accepted for disposal (refer to Section 2.1.3 for waste stream compatibility).

3.3 MANAGEMENT OF WASTE

The ILAW, BVW, and newly generated wastes (see Section 1.3.1) generated during normal operations of this TSD unit are accepted at this TSD unit for disposal. The two onsite TSD units (RPP-WTP and DBVS) transferring/shipping waste to this TSD unit hereafter are referred to as the 'generator' unless otherwise denoted in this WAP. The waste acceptance process for transfers from the generator is identified in Figure 1.

Written waste tracking procedure(s) are implemented to ensure waste received at the TSD unit matches the manifest or transfer papers, to ensure that the waste is tracked though the TSD unit to final disposition, and to maintain the information required in WAC 173-303-380. The waste tracking process provides a mechanism to track waste through a uniquely identified container. The unique identifier is a barcode (or equivalent) that is recorded in the Solid Waste Information Tracking System (SWITS). This mechanism encompasses the waste acceptance process, the movement of waste, the processing of waste, and management of the waste. The container identification number provides traceability between the TSD unit and the hard copy of records that are maintained as part of the operating record to ensure information relative to the location, quantity, and physical and chemical characteristics of the waste are available.

The following sections describe the process for waste acceptance and the different types of information and knowledge reviewed/required during the acceptance process. The process for management of waste is described in Chapter 4.0

3.3.1 Newly Generated Waste within the IDF

This TSD unit generates mixed waste as a result of operational (e.g., chemical, radiological) activities. These activities include, transfer functions along with inspection, decontamination, cleanup, maintenance tasks and leachate collection. The IDF generated operational waste will be maintained in accordance with generator provisions of WAC 173-303-200 and WAC 173-303-600 (3) (d). Any newly generated waste (except leachate) not meeting IDF waste acceptance criteria will be designated and sent to another permitted TSD or to a 90 day accumulation area. IDF leachate will be managed in accordance with WAC 173-303-200 and transferred to LERF/ETF (or other permitted TSD) for treatment. Solids or residuals resulting from IDF leachate treatment may be designated/packaged and sent back to the IDF for burial or to another permitted TSD.

Figure 1. Waste Transfers and Analysis Plan Onsite TSD Units Flow Diagram.

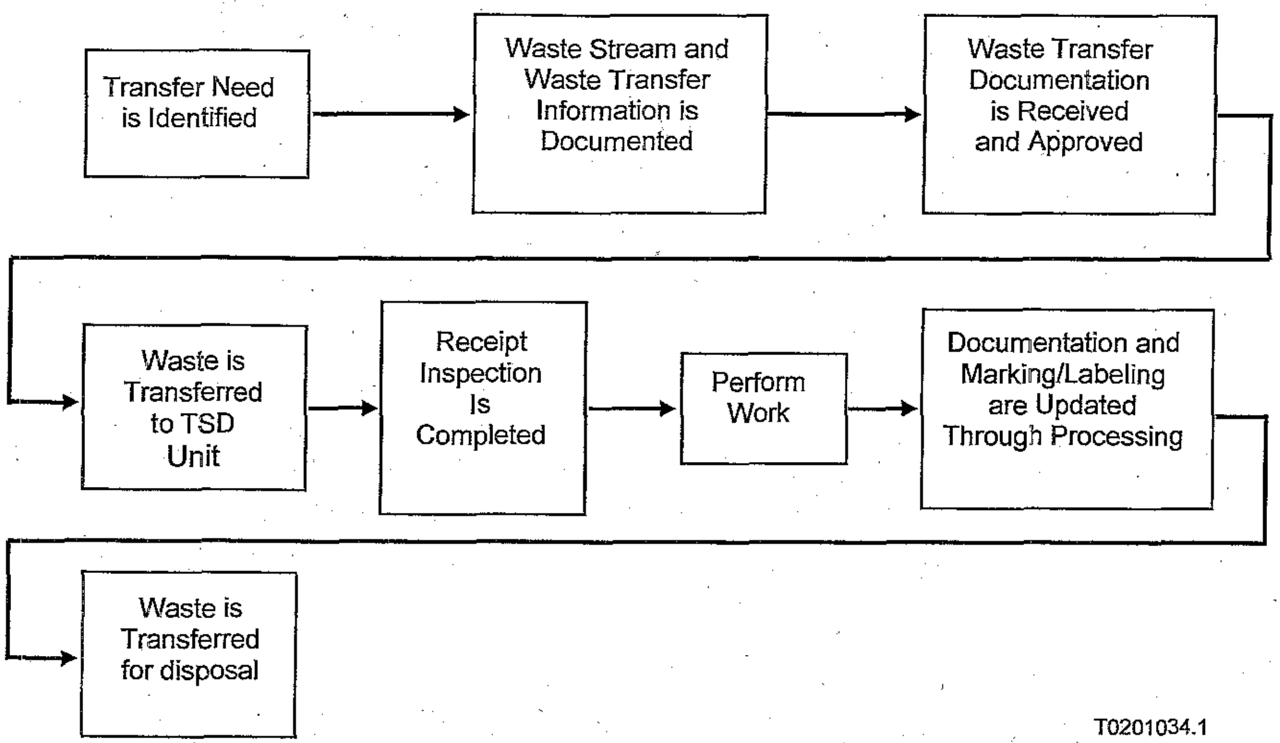


Table 1. Chemicals Incompatible With the High Density Polyethylene Liner (in concentrated form)*

Chemical	CAS Number
Amyl chloride	543-59-9
Aqua regia	8007-56-5
Bromic acid	15541-45-4
Bromobenzene	108-86-1
Bromoform	75-25-2
Calcium bisulfite	13780-03-5
Calcium sulfide	20548-54-3
Diethyl benzene	25340-17-4
Diethyl ether	60-29-7
Bromine	7726-95-6
Chlorine	7782-50-5
Fluorine	7782-41-4
Ethyl chloride	75-00-3
Ethylene trichloride	79-01-6
Nitrobenzene	98-95-3
Perchlorobenzene	118-74-1
Propylene dichloride	78-87-5
Sulfur trioxide	7446-11-9
Sulfuric acid (fuming)	8014-95-7
Thionyl chloride	7719-09-7
Vinylidene chloride.	75-35-4

CAS = Chemical Abstract Service.
* WHC-SD-WM-TI-714

3.4 CONFIRMATION PROCESS

WAC 173-303-300 (1) requires confirmation on mixed waste before acceptance of waste into a waste management unit. The confirmation process consists of two parts, pre-shipment review, and verification. Confirmation activities are performed in accordance with TSD unit-specific governing documentation. The confirmation process is detailed in Figure 2 for ILAW and BVW.

3.4.1 Pre-Shipment Review

Pre-shipment review takes place before waste can be scheduled for transfer or shipment to this TSD unit. The review focuses on whether the waste stream is defined accurately and meets the TSD unit waste acceptance criteria and whether the LDR status is determined correctly. Only waste determined to be acceptable for storage (see Section 4.0) and/or disposal is scheduled. This determination is based on the information provided by the generator. The pre-shipment review consists of waste stream approval and the waste shipment approval process. The following sections discuss the pre-shipment review process. The information obtained during the pre-shipment review, at a minimum, includes all information necessary to safely dispose of the waste. The pre-shipment review ensures the waste is characterized and the data provided qualify as 'acceptable knowledge' (Section 2.1.5).

3.4.1.1 Pre-Shipment Review of Wastes

Pre-shipment review for ILAW and BVW waste containers will take place at RPP-WTP and the DBVS staging area respectively before either type of containers can be scheduled for transfer to the IDF. The review will focus on whether the waste stream is defined accurately, meets the waste acceptance criteria, and the land disposal restrictions (LDR) status was determined correctly. Only waste determined to be acceptable for storage (see section 4.0) and/or disposal will be scheduled. This determination will be based on the information provided by the generator. The pre-transfer review will consist of the waste profile documentation and waste transfer approval process. The following sections discuss the pre-transfer review process. ILAW and BVW containers received for land disposal will be at least 90 % full. The information obtained from the generator, at a minimum, will contain five elements: (1) documentation to ensure waste can be managed pursuant to the Part A, Form 3, (2) documentation to ensure the waste is not a prohibited waste in accordance with Section 1.2, (3) a determination if the waste is an ignitable, reactive, or incompatible waste as defined in WAC 173-303-040, (4) documentation that waste meets LDR requirements of 40 CFR 268 and WAC 173-303-140, and (5) operational restrictions on acceptance of waste.

During the waste profile documentation process for ILAW and BVW containers, the generator will have the responsibility to provide relevant information pertaining to the proper management of the waste. Characterization information pertaining to the treatment of ILAW and BVW will be obtained during the waste profile documentation process.

3.4.1.2 Waste Stream Approval Process for Wastes

The waste stream approval process consists of reviewing stream information supplied on a waste stream profile and supporting documentation to allow receipt of the waste into the IDF. Waste stream compatibility (i.e., compatibility between individual waste streams and compatibility between waste streams and landfill design and construction parameters) will be assessed on a case-by-case basis. Criteria for assessing and determining compatibility will be identified in either the facility Waste Acceptance Criteria, Waste Analysis Plan, or other protocol or procedure as appropriate

3.4.1.2.1 Waste Stream Approval for ILAW and BVW

During the waste profile documentation process, the IDF waste acceptance organization will obtain the following information:

- Description of waste generating process
- Characterization data
- Dangerous waste numbers
- LDR data (as specified in Section 7.0)
- Composition of ILAW and BVW including regulated constituents of concern (refer to Chapter 1.0 of the permit application -Part A Form).

The waste profile documentation process will be as follows.

1. Appropriate generator fills out waste profile documentation.
2. The IDF designated waste acceptance organization reviews the waste profile information against the waste acceptance criteria for each ILAW or BVW transfer.
3. If discrepancies are noted, the IDF designated waste acceptance organization requests additional information from the generator to address discrepancies for either: (1) inconsistent information and (2) information not constituting acceptable knowledge (refer to Section 2.1.5).

   Information (waste profile documentation) is resubmitted by the generator addressing concerns in Item 3.

   - If concerns are addressed, waste profile documentation is approved.
   - If concerns are not addressed and met, waste profile documentation is not approved until concerns are corrected.

3.4.1.2.2 Waste Stream Approval for Newly Generated Mixed Waste

The waste stream approval process for wastes generated during IDF operations (except for leachate) consists of reviewing stream information supplied on a waste stream profile and supporting documentation. The waste stream profile requires the following supporting documentation:

- Generator information (e.g., name, address, point-of-contact, telephone number)
- Waste stream name
- Waste generating process description
- Waste numbers
- Chemical characterization information [e.g., characterization method(s), chemicals present, concentration ranges]
- Designation information
- LDR information including identification of underlying hazardous constituents if applicable
- Waste type information (e.g., physical state, adsorbents used, inert materials, stabilizing agents used)
- Packaging information (e.g., container type, maximum weight, size).

Attachments could consist of container drawings, process flow information, analytical data, etc.

In some cases, such as variable waste streams, the waste stream profile information could be general in nature. In these cases, more detailed information is gathered during the waste shipment approval process on a per shipment basis. This information is reviewed against the TSD unit waste acceptance criteria to ensure the waste is acceptable for receipt. If conformance issues are found during this review, additional information is requested that could include analytical data or a sample to be analyzed. If the waste cannot be received, the TSD unit pursues acceptance of the waste at an alternate TSD unit. Once the waste meets the waste acceptance criteria, the TSD unit assigns the profile to a waste specification record and establishes a waste verification frequency based on the requirements found in Section 2.3. Profile information is re-evaluated as discussed in Section 6.0.

3.4.1.3 Waste Transfer/Shipment Approval Process

After the appropriate generator has received the waste profile documentation approval from IDF (refer to Section 2.1.3), the generator waste transfer will be subjected to the waste transfer approval process. Only those ILAW and BVW containers approved under the waste profile documentation as part of the waste transfer approval process will be transferred to the IDF. During the waste transfer approval process, the IDF designated waste acceptance organization will obtain the following information.

For each ILAW or BVW container transfer that is a candidate for disposal in the TSD unit, the generator will provide the following information:

- Container identification number
- Profile number
- Waste description
- Generator information (e.g., name, address, point-of-contact, telephone number)
- Container information (e.g., type, size, weight)
- Waste numbers
- LDR certification
- Packaging materials and quantities.

The ILAW and BVW container transfer approval process will be as follows.

1. The generator obtains information from existing database, operating record, or generator records on each ILAW container to be transferred under the approved waste profile documentation.
2. Information is submitted to the TSD unit designated waste acceptance organization by the generator and is reviewed for the following:
    - Consistency with approved waste profile documentation
    - Consistency with waste acceptance criteria within the IDF.
3. If discrepancies are identified, the TSD unit designated waste acceptance organization will request additional information from the generator to address any discrepancies.
4. Information (waste package documentation) is resubmitted by the generator addressing concerns in Item 3.
5. If discrepancies are addressed, this information is forwarded to the TSD waste acceptance organization.
6. If discrepancies are not addressed, transfer is not approved until discrepancies are corrected.

3.4.1.4 Acceptable Knowledge Requirements

The TSD unit ensures that all information used to make waste management decisions is based on adequate characterization data as described in the following sections. The TSD unit evaluates the data to ensure that the data are adequate acceptable knowledge for management of the waste.

3.4.1.4.1 General Acceptable Knowledge Requirements

One or more of the following types of information could be considered, provided that the information is of sufficient quality to demonstrate compliance with applicable waste acceptance criteria:

- Mass balance from a controlled process that has a specified output for a specified input
- Material safety data sheet on chemical products
- Test data from a surrogate sample
- Analytical data on the waste or a waste from a similar process.

In addition, acceptable knowledge requirements can be met using a combination of analytical data or screening results and one and/or more of the following information:

- Interview information
- Logbooks
- Procurement records
- Qualified analytical data
- Radiation work package
- Procedures and/or methods
- Process flow charts
- Inventory sheets
- Vendor information
- Mass balance from an uncontrolled process (e.g., spill cleanup)
- Mass balance from a process with variable inputs and outputs (e.g., washing/cleaning methods).

If the information is sufficient to quantify the constituents of regulatory concern and to determine waste characteristics as required by the regulations and TSD unit waste acceptance criteria, the information is considered acceptable. Adequate acceptable knowledge includes (1) general waste knowledge requirements and/or (2) LDR waste knowledge requirements.

(1) **General waste knowledge requirements**. At a minimum, the generator supplies enough information for the waste to be managed at this TSD unit (refer to Section 2.1.3). The minimum level of acceptable knowledge consists of designation data where the constituents causing a waste number to be assigned are quantified and that data address any TSD unit operational parameters necessary for proper management of the waste.

When process knowledge indicates that constituents, which if present in the waste might cause the waste to be regulated, are input to a process, but not expected to be in the waste, sampling and analysis must be performed to ensure the constituents do not appear in the waste above applicable regulatory levels. This requirement can be met through chemical screening. This sampling and analysis are required only for initial characterization of the waste stream.

When the available information does not qualify as acceptable knowledge or is not sufficient to characterize a waste for management, the sampling and testing methods outlined in WAC 173-303-110 are used to determine whether a waste designates as ignitable, corrosive, reactive, and/or toxic and whether the waste contains free liquids as applicable. If the analysis is performed to complete characterization after acceptance of the waste by the TSD unit, this WAP governs the sampling and testing requirements.

(2) **LDR waste knowledge.** The TSD unit operating record contains all information required to document that the appropriate treatment standards have been met or will be met after the waste is treated unless otherwise excepted in this section.

- Both ILAW and BVW will be LDR compliant waste streams prior to acceptance at the IDF. Vitrification at the WTP and DBVS will facilitate LDR compliance for the majority of the mixed waste disposed of at IDF. IDF operational waste will be treated as needed to meet LDR at another TSD other than WTP or the DBVS

- This TSD unit may use analytical data as necessary to ensure that the applicable requirements found in 40 CFR 268.7 and WAC 173-303-140 (4) are met.

3.4.1.4.2 Methodology to Ensure Compliance with LDR Requirements

The generators are subject to LDR requirements and are required to submit all information notifications and certifications described in WAC 173-303-380 (1), (j), (k), (n), and (o). Mixed waste not meeting the treatment standards cannot be disposed at this TSD unit.

The following are general requirements for certification or information notification.

- The waste is subject to LDR and the waste has been treated. The generator supplies the appropriate LDR certification information (40 CFR 268).

- The waste is subject to LDR and the generator has determined that the waste meets the LDR as generated. The generator develops the certification based on process knowledge and/or analytical data and supplies the appropriate LDR certification information necessary to demonstrate compliance with the LDR treatment standards of 40 CFR 268 and WAC 173-303-140. State-only LDRs do not require this type of certification.

When demonstrating that a concentration-based LDR treatment standard has been met, a representative sample of the waste must be submitted for analysis. This sample could be taken by the treatment facility or the generator and is required to comply with the LDR treatment standards contained in 40 CFR 268.40 and 268.48 for underlining hazardous constituents.

3.4.2 Verification

Verification is an assessment performed by this TSD unit to substantiate that the waste received is the same as represented by the analysis supplied by the generator for the pre-shipment review. Verification for ILAW and BVW containers will contain one element, a 100% container receipt inspection. Physical/chemical screening will not be performed on the ILAW or BVW containers. Waste is not accepted by the TSD unit for disposal until the required elements of verification have been completed, including evaluation of any data obtained from verification activities. All conformance issues identified during the verification process are resolved in accordance with Section 2.3.3. Verification activity results will be documented by the IDF designated waste acceptance organization.

Sampling and analysis for non-vitrification mixed waste (e.g., treatment residues from treatment of IDF leachate that are returned to IDF for disposal) will not occur at the IDF but will occur at another permitted TSD.

3.4.2.1 Container Receipt Inspection

Container receipt inspection is a mandatory element of the confirmation process.

3.4.2.1.1 Container Receipt Inspection for ILAW and BVW

The ILAW and BVW container receipt inspection will be performed by IDF designated waste acceptance organization. The following criteria will be evaluated during container receipt inspection:

- Number of containers
- Size of containers
- Labels
- Container integrity.

Discrepancies identified during the container receipt inspection will be communicated to generator. Discrepancies will be resolved before the containers are unloaded. Once the discrepancies are resolved, the ILAW containers will be unloaded and disposed. Should discrepancies remain unresolved after 30 days, Ecology will be notified and daily walk around inspections conducted.

3.4.2.2 Physical Screening Process

The ILAW and BVW containers are not required to be physically screened because the generator verifies the waste meet the waste acceptance criteria for IDF.

3.4.2.3 Chemical Screening Process

Chemical screening is a verification element for containerized mixed waste. The ILAW and BVW containers are not required to be chemically screened because the generator verifies the waste meet the waste acceptance criteria for IDF.

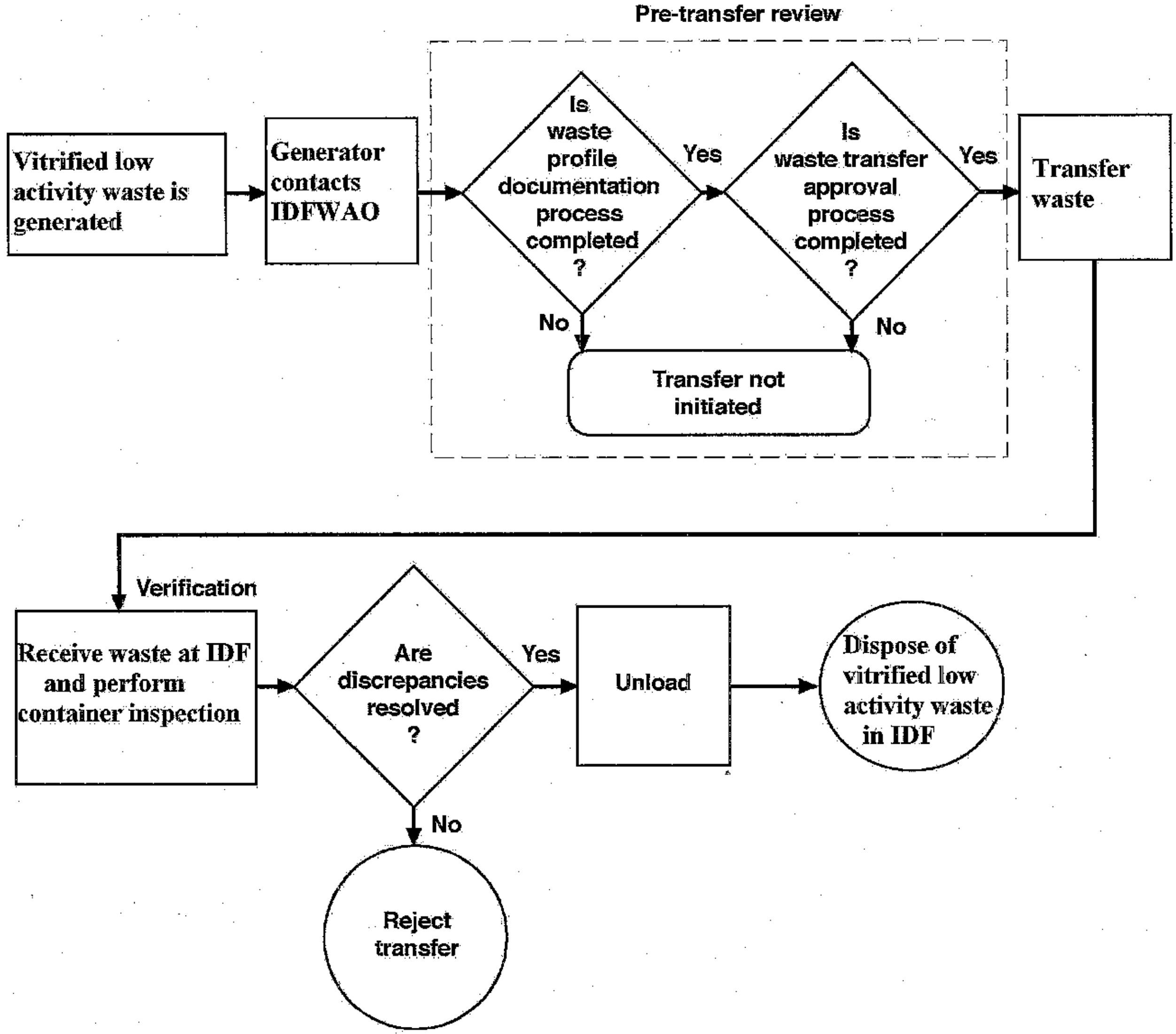
3.4.3 Waste Acceptance

Initial acceptance of waste occurs only after the confirmation process described in Section 2.0 is complete. Conformance issues identified during the confirmation process are documented and managed in accordance with Section 2.3. Conformance issues that must be corrected before waste acceptance include the following:

- Waste that is not identified in the Part A, Form 3 (Chapter 1.0)
- Waste does not match approved profile documentation
- Designation, physical, and/or chemical characterization discrepancy
- Incorrect LDR paperwork
- Packaging discrepancy
- Manifest discrepancies as described in WAC 173-303-370(4).

For waste shipments with unresolved conformance issue(s) that exceed 90 days, this TSD will notify Ecology at least once per calendar quarter.

Figure 2. Vitrification or Alternative Method Transfer and Waste Analysis Plan Process Flow Diagram



IDF = Integrated Disposal Facility
IDFWAO = IDF Waste Acceptance Organization

3.4.4 Selecting Waste Analysis Parameters

The ILAW and BVW containers will be managed without the need to perform sampling and analysis at the TSD. No parameters will be required to be identified.

Table 2. Parameters and Rationale for Physical Screening

Parameter	Method*	Rationale for selection
Nondestructive examination	Field method	Confirm consistency between waste and shipping documentation.

*Procedures based on manufacturer's recommended methodology unless otherwise noted. When regulations require a specific method, the method is followed.

SW-846, *Test Methods for Evaluating Solid Waste*, latest edition, U.S. Environmental Protection Agency, Washington, D.C.

WAC 173-303, "Dangerous Waste Regulations

3.4.5 Selecting Sampling Procedures

Any required sampling and analysis of the ILAW and BVW containers will be performed at the generator before the containers are closed. Sampling and analysis for IDF operational mixed waste will not occur at the IDF but at another Hanford TSD.

3.4.6 Selecting A Laboratory, Laboratory Testing, And Analytical Methods

Any required sampling and analysis of the ILAW and BVW containers will be performed before the containers are closed at the RPP-WTP and DBVS respectively. No Laboratory, laboratory testing or analytical methods will be required to be identified.

3.4.7 Selecting Waste Re-Evaluation Frequencies

The re-evaluation (repeat and review) frequency for ILAW to review a waste generating process and associated waste profile documentation is every 2 years, or more often if conditions in WAC 173-303-300(4)(a) arise. Since BVW will be generated over a shorter time period, frequency for review will be every six months.

When a waste generating process and associated waste profile documentation is re-evaluated, IDF personnel or designated waste acceptance organization could request the generator to do one or more of the following:

- Verify the current waste profile documentation is accurate
- Supply new waste profile documentation.

When a waste profile is re-evaluated, the TSD unit could request the organization generating the waste to do one of the following:

- Verify the current waste profile is accurate
- Supply a new waste profile
- Submit a sample for parameter analysis.

3.4.8 Special Waste Analysis Procedural Requirements

Special procedural requirements for the IDF will include procedures for ignitable, reactive, and incompatible waste, and provisions for complying with federal and state LDR requirements. This section discusses any special process requirements for receiving mixed waste at this TSD unit.

3.4.9 Procedures for Ignitable, Reactive, and Incompatible Waste

Waste stream compatibility (i.e., compatibility between individual waste streams and compatibility between waste streams and landfill design and construction parameters) and waste stream ignitability will be assessed on a case-by-case basis. Criteria for assessing and determining compatibility and ignitability will be identified in either the facility Waste Acceptance Criteria, Waste Analysis Plan, or other protocol or procedure as appropriate. Should these wastes be accepted, appropriate administrative and engineering controls will be implemented as necessary.

This TSD unit does not accept reactive waste (refer to Section 1.2 and Section 2.0). The TSD unit ensures that reactive waste is not accepted at this TSD unit in the following manner.

- Pre-shipment review will identify whether the waste is reactive based on the definition contained in WAC 173-303-040.
- If analysis of the characterization information leads to a conclusion that the waste is a reactive waste, the containers, or waste will not be accepted.

The types of prohibited waste not accepted at this TSD unit as listed in Section 1.2.

3.4.10 Provisions for Complying With Federal and State Land Disposal Restriction Requirements

State-only and federal LDR requirements restrict the land disposal of certain types of waste subject to RCRA and RCW 70.105, "Hazardous Waste Management", as amended. Waste managed on the Hanford Facility falls within the purview of these LDRs per 40 CFR 268 and WAC 173-303-140. The treatment standards for mixed waste disposed at IDF are based on the dangerous waste numbers accepted as documented on the IDF Part A as well as additional information necessary for identifying treatability groups etc.

The IDF will not perform sampling and analysis to determine compliance with treatment standards contained in 40 CFR 268. Any sampling and analysis results required to demonstrate compliance with concentration-based treatment standards contained in 40 CFR 268.40 will be obtained by IDF waste acceptance organization from the generator, during the waste profile documentation process to meet the requirements of 40 CFR 268.7(c)(2). Sampling and analysis results will be placed into the unit-specific portion of the Hanford Facility operating record. Other LDR records are identified in WAC 173-303-380(1)(m) and will be obtained from the generator, by IDF personnel as part of either the waste profile documentation process or the waste transfer approval process. The treated waste must meet all applicable LDRs to be accepted for disposal at the IDF. IDF will obtain the LDR certification from the treatment unit.

Mixed waste constituents that are subject to LDRs are identified in 40 CFR 268.40 by reference in WAC 173-303-140(2), the extremely hazardous waste disposal requirements for DOE facilities contained in RCW 70.105.050(2), and the state-only LDRs contained in WAC 173-303-140(4)(b)-(d). The mixed waste must meet certain treatment standards, as specified in 40 CFR 268.40, RCW 70.105.050(2), and WAC 173-303-140(4)(b)-(d), if the waste is to be land disposed. Any waste requiring LDR treatment must be treated prior to acceptance into the IDF.

State-only LDRs for mixed waste will be met in the following manner:

- Extremely hazardous waste disposal requirements in RCW 70.105.050(2) concerning "all reasonable methods" will be met by the treatment performed to meet 40 CFR 268, WAC 173-303-140(4)(b)-(d), and DOE requirements for disposal. If no treatment is required to meet 40 CFR 268, WAC 173-303-140(4)(b)-(d), or DOE requirements, no treatment is required to dispose of extremely hazardous waste at the IDF.
- Special requirements for bulk and containerized liquids in WAC 173-303-140(4)(b) are identical to the landfill requirements contained in 40 CFR 264.314. For mixed waste, including the provisions when to perform the paint filter test, these requirements are described in Section 1.2 of the WAP.
- Solid acid waste requirements in WAC 173-303-140(4)(c) can be met through knowledge of the treatment process. Sampling and analysis following treatment is not required to meet this state-only LDR. Disposal of treated solid acid waste still displaying the WSC2 characteristic can occur only when the waste is treated to reduce the harmful properties or characteristics of the waste.
- Organic/Carbonaceous waste prohibition requirements in WAC 173-303-140(4)(d) do not apply to the Hanford Facility because the Hanford Facility is operating under WAC 173-303-140(4)(d)(iii), in accordance with a sitewide 1,609 kilometers (1,000-mile) inapplicability certification. Sampling and analysis is not required to determine the organic/carbonaceous content of a mixed waste.
- Ecology allows treatment of Organic/Carbonaceous waste in lieu of meeting the inapplicability certification requirements (WAC-173-303-140(4)(d)(iii) through macro-encapsulation for hazardous debris only.

3.4.11 Off-Specification Waste

Off-Specification ILAW or BVW is waste not meeting the waste acceptance criteria as described in Section 2.0, Confirmation Process. ILAW or BVW streams determined to be off-specification may be temporarily stored in the RCRA lined portion of the IDF pending resolution of discrepancy or return to generating TSD as long as these wastes meet LDR. ILAW and BVW may be temporarily stored in the RCRA lined portion of the IDF, provided the temperature administrative control limit is not exceeded, until sufficiently cool for disposal.

3.5 WASTE TRACKING

The IDF will monitor and record the placement of waste packages. At the time of final placement of each package, the position and serial number of the package will be logged.

3.6 RECORDKEEPING

Recordkeeping requirements that will be applicable to this WAP are described in Chapter 12.0, and as follows:

- Confirmation records described in Section 2.0 will be maintained in accordance with Condition II.I.1.b of the Hanford Facility RCRA Permit, Dangerous Waste Portion (Ecology 2001).
- Waste profile documentation described in Section 2.0 will be maintained in accordance with Condition II.I.1.j of the Hanford Facility RCRA Permit, Dangerous Waste Portion.
- LDR records described in Section 7.0 will be maintained in accordance with WAC 173-303-380(1)(m) in the IDF unit-specific portion of the Hanford Facility operating record.

3.7 REFERENCES

AOAC, 2000, *Official Methods of Analysis of AOAC International*, Vols. I and II, 17^{th} Edition, Association of Official Analytical Chemists, Gaithersburg, Maryland.

APHA, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20^{th} Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

ASTM, 2002, *Annual Book of ASTM Standards*, American Society for Testing and Materials, Philadelphia, Pennsylvania.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Chapter 4.0 **Process Information**

Appendices

Figures

4.0 PROCESS INFORMATION [D]

This chapter discusses the processes that will be used to dispose waste in the IDF and includes a discussion of the design and function of the following:

- Container
- Disposal landfill
- Leak detection system
- Leachate collection and removal system
- Secondary leak detection system (Note that the SLDS is not a design requirement of WAC 173-303-665, however DOE is adding the design feature pursuant to its authority under the Atomic Energy Act of 1954 (AEA) and not for the purposes of compliance with the dangerous waste regulations. Therefore information regarding the design, construction and operation of the secondary leak detection system is provided in this application as information only. Pursuant to AEA, DOE has sole and exclusive responsibility and authority to regulate the source, special nuclear and by-product material component of radioactive mixed waste at DOE-owned nuclear facilities. Source, special nuclear and by-product materials, as defined by AEA, are not subject to regulation under RCRA or the Hazardous Waste Management Act, by the State of Washington and are not be subject to State dangerous waste permit, orders, or any other enforceable instrument issued thereunder. DOE recognizes that radionuclide data may be useful in the development and confirmation of geohydrologic conceptual models. Radionuclide data contained herein is therefore provided as a matter of comity so the information may be used for such purposes).

Waste stream compatibility (i.e., compatibility between individual waste streams and compatibility between waste streams and landfill design and construction parameters) will be assessed on a case by case basis. Criteria for assessing and determining compatibility will be identified in either the facility Waste Acceptance Criteria, Waste Analysis Plan, or other protocol or procedure as appropriate (refer to Chapter 3.0, for further discussion of waste stream compatibility).

Process Code S01 (container storage) has been included within this permit application, in the event that storage is required before final disposal (e.g., to support the confirmation process of the waste or cooling of vitrified waste if required). Waste failing the confirmation process (Chapter 3.0) will be identified as off-specification and may require storage prior to disposal. Only off-specification waste or vitrified waste requiring cooling (due to process heat) may be stored in the lined portion of the IDF pending disposition. To maintain operational flexibility, off-specification containers and vitrified waste requiring cooling could be left on the transport vehicles at the IDF until disposal can occur but may be off-loaded into the lined portion of the IDF pending final disposal provided the temperature administrative control limit is not exceeded. Off-specification waste and vitrified waste requiring cooling will be separated from other waste via tape, ropes, chains, or other cordon mechanism.

4.1 CONTAINERS [D-1]

All mixed waste accepted for disposal at the IDF will be packaged in standard containers [U.S. Department of Transportation (DOT) and/or DOE], unless alternate packages are dictated by the size, shape, or form of waste (49 CFR 173) (e.g., metal boxes), and self contained bulk waste.

4.1.1 Description of Containers [D-1a, D-1b, and D-1c]

Mixed waste disposed at the IDF is limited to vitrified low-activity waste (LAW) from the RPP-WTP and DBVS. Additionally, mixed waste generated by IDF operations will be disposed of in IDF.

The RPP-WTP and DBVS containers are designed specifically for the vitrified low activity waste form. Nominal RPP-WTP container dimensions will be 122 centimeters base outside dimension, 107 centimeters top by 230 centimeters in length, with a wall thickness of 0.357 centimeter with a container volume of 2.55 cubic meters. The DBVS container dimensions are approximately 2.4 meters wide by 3.1 meters tall and 7.3 meters long and a container volume of 54 cubic meters. The vitrified low activity waste will be compatible with the containers, stainless steel for RPP-WTP and carbon steel for DBVS. Before receipt at the IDF, containers will be closed by the generator.

Due to the radioactivity and remote handling of the RPP-WTP immobilized waste containers, conventional labeling of the vitrified immobilized waste containers will not be feasible and an alternative to the standard labeling requirements will be used. This alternative labeling approach will use a unique alphanumeric identifier that will be welded onto each immobilized glass waste container. The welded "identifier" will ensure that the number is always legible, will not be removed or damaged during container decontamination, will not be damaged by heat or radiation, and will not degrade over time.

The identifier will be welded onto the shoulder and side wall of each immobilized glass container at two locations 180 degrees apart. Characters will be approximately 2 in. high by 1.5 in. wide. The identifier will be formed by welding on stainless steel filler material at the time of container construction. This identifier will be used to track the container from receipt at the RPP-WTP, throughout its subsequent path of shipment and disposal at the IDF.

Each identifier will be composed of unique coded alphanumeric characters. This unique alphanumeric identification will be maintained within the plant information network, and will list data pertaining to the waste container including waste numbers, and the major risk(s) associated with the waste.

Mixed waste generated through waste operations at IDF will be packaged based on the size of the waste, with the most common container being galvanized or aluminized 208 liter containers.

The container packaging and handling for the IDF are designed to maintain containment of the waste, limit storage intrusion, and limit human exposure to mixed waste. Unusual sized containers such as vitrified LAW packages will be handled by using cranes or other appropriate equipment.

Operations personnel will inspect each container to confirm appropriate documentation and compliance with the waste acceptance criteria before the container is placed in the IDF (refer to Chapter 3).

If containerized mixed waste must be opened (i.e., for confirmation sampling, repackaging, etc.), the container typically would be removed to an onsite treatment and/or storage unit or other approved location before being opened. The container would be sealed before being returned to the IDF.

4.2 LEACHATE COLLECTION TANKS

The aboveground leachate collection tank will support the lined IDF landfill. The leachate collection tank will be operated in accordance with the generator provisions of WAC 173-303-200 and WAC 173-303-640 as referenced by WAC 173-303-200.

For informational purposes, the following is provided for an understanding of the operation of the Leachate Collection Tank. Procedures will be written to manage the leachate in accordance with WAC 173-303-200. The presence of leachate in the tank will be detected with instrumentation within the two stilling wells. The level instrument within the first stilling well will monitor the depth of leachate in the tank. A second stilling well will have instrumentation for high-high and low-low alarm set-point trips. The leachate will be removed from the tank using a transfer pump.

4.3 LANDFILLS [D-6]

The following addresses the IDF lined landfill.

4.3.1 List of Wastes [D-6a]

IDF will receive mixed and/or dangerous waste.

Waste will be accepted in containers (e.g. drums, boxes, larger containers).

Waste streams acceptable at the IDF facility will fall within the range of dangerous waste numbers identified in the Part A form (see chapter 1.0)

4.3.2 Liner System Exemption Requests [D-6b]

This permit application documentation does not seek an exemption to liner system requirements.

4.3.3 Liner System, General Items [D-6c]

This section provides a general description of the liner system to be used for the IDF lined landfill (Figure 4-1).

The liner system was designed to prevent migration of leachate out of the lined landfill during the active life of the landfill. The active life will consist of the operational period and the closure/postclosure period. The liner system was designed to meet U.S. Environmental Protection Agency (EPA) requirements, as identified in RCRA Subtitle C requirements for hazardous waste disposal facilities (40 CFR 264), technical guidance documents (e.g., EPA 1985), and WAC-173-303-665. In addition, the liner system will incorporate the following general functional requirements:

- Range of Operating Conditions--year-round operation, withstand construction, and long-term stresses
- Degree of Reliability--function safely and effectively throughout operating and closure/postclosure period with minimum maintenance
- Intended Life--operational phase plus closure/postclosure monitoring phase.

4.3.3.1 Liner System Description [D-6c(1)]

The landfill liner system will comply with WAC 173-303-665 requirements for dangerous waste landfills. Figure 4-2 shows a typical design and includes the following components (from top to bottom).

- Operations layer: minimum 0.9-meter thick of native soil. This layer will provide a working surface for equipment, protect the liner from mechanical damage, and prevent freezing of the underlying low-hydraulic conductivity soil layer. (Hydraulic conductivity is a measure of how rapidly a material can transmit water and is based on specific ASTM testing requirements.)
- Leachate collection and removal system (LCRS) will contain a minimum 0.3-meter-thick drainage gravel layer with a hydraulic conductivity of at least 1×10^{-2} centimeter per second (sometimes including perforated drainage pipes). A nonwoven separation geotextile is located between the operations layer and the drainage gravel layer to minimize sediment (fine-soil) migration into the LCRS. A nonwoven cushion geotextile is located between the drainage gravel and the primary geomembrane to protect the primary geomembrane.

The LCRS liners will collect and convey leachate to the LCRS sump for removal and will include the following components.

- Primary geomembrane liner: this liner will consist of high-density polyethylene (HDPE) because of its excellent resistance to expected chemicals (refer to Chapter 1.0); nominal 60-mil thickness (54-mil minimum), which is textured (to improve stability against sliding). The geomembrane will act as a moisture barrier. Located immediately above the primary geomembrane the LCRS will include a perforated pipe that helps collect and guide water into the leachate collection sump. The perforated pipe is located along the centerline of the cell and provides high-flow path water to the primary collection sump.

- Primary geosynthetic clay liner (GCL): the GCL consisting of a high-swelling sodium synthetic mat containing bentonite with a hydraulic conductivity of 1×10^{-8} centimeter per second or less. This layer will act as an additional primary moisture barrier directly under the primary geomembrane.

The leak detection system (LDS) is similar to the LCRS except the composite drainage net (CDN) replaces the primary gravel layer, the geosynthetic clay liner (GCL) will be placed directly under the secondary geomembrane liner only under the LDS sump and the perforated pipes will not be needed because very high flow capacities will not be required. The purpose of this system will be to collect any leachate that leaks through the primary liner system and convey the leachate to the LDS sump for removal. The LDS also will serve as a secondary LCRS. The LDS liners will collect and convey leakage to the LDS sump and will include the following components:

- Secondary geomembrane liner: same as primary geomembrane liner.

- Secondary geosynthetic clay liner: same as primary geosynthetic clay liner.

- Admix liner: a minimum 0.9-meter-thick layer of compacted soil/bentonite admixture with a hydraulic conductivity of 1×10^{-7} centimeter per second or less. The bentonite will be high-swelling sodium bentonite. This layer will act as an additional moisture barrier directly under the secondary geosynthetic clay liner in the LDS sump area and the secondary geomembrane outside the LDS sump area.

- The secondary leak detection system (SLDS) consists of operations layer type fill for a foundation of the LDS admix layer, drainage gravel with a hydraulic conductivity of at least 1×10^{-2} centimeter per second adjacent to a perforated pipe, a composite drainage net (CDN) and tertiary geomembrane. A nonwoven separation geotextile is located between the operations layer type material and the drainage gravel to minimize sediment (fine-soil) migration into the SLDS piping. The purpose of this system is to provide access to the area immediately below the LDS sump area. The SLDS will collect liquids resulting from construction water and potentially, liquid from other sources. The SLDS liners will convey collected liquids to the SLDS piping for monitoring and/or removal. (Note that the secondary leak detection system is not a design requirement of WAC 173-303-665, however DOE is adding the design feature pursuant to its authority under the Atomic Energy Act of 1954 (AEA) and not for the purposes of compliance with the dangerous waste regulations. Therefore information regarding the design, construction and operation of the secondary leak detection system is provided in this application as information only. Pursuant to AEA, DOE has sole and exclusive responsibility and authority to regulate the source, special nuclear and by-product material component of radioactive mixed waste at DOE-owned nuclear facilities. Source, special nuclear and by-product materials, as defined by AEA, are not subject to regulation under RCRA or the Hazardous Waste Management Act, by the State of Washington and are not be subject to State dangerous waste permit, orders, or any other enforceable instrument issued thereunder. DOE recognizes that radionuclide data may be useful in the development and confirmation of geohydrologic conceptual models. Radionuclide data contained herein is therefore provided as a matter of comity so the information may be used for such purposes).

4.3.3.1.1 Operations Layer

The purpose of the operations layer will be to protect the underlying liner components from damage by equipment during lined landfill construction and operation. This layer also will protect the admix layer from freezing and desiccation cracking.

Previous research and experience has shown that desiccation cracks can occur under geomembrane liners when either the liner is not in close contact with the compacted admix or when the liner is subjected to wide temperature fluctuations (Corser and Cranston 1991). The operations layer will act as a weight to keep the geomembrane in contact with the admix, thereby reducing the potential for water vapor to form in an underlying airspace. The operations layer also will act as an insulating layer, together with the dead air space trapped in the underlying drainage layers.

The operations layer material typically will consist of onsite granular soil that is reasonably well graded. The material will have a maximum particle size limit of 5.1 centimeters or less, to facilitate protection of the underlying layers.

4.3.3.1.2 Leachate Collection and Removal System

The LCRS will be located below the operations layer and will provide a flow path for the leachate flowing into the LCRS sump. Between the operations layer and the underlying drainage gravel, a geotextile layer will function as a filter separation barrier. The geotextile will prevent migration of fine soil and clogging of the drainage gravel. On the lined landfill floor the drain gravel will be a minimum 0.3-meter-thick layer of washed, rounded to subrounded stone, with a hydraulic conductivity of at least 1×10^{-2} centimeter per second. In addition, a perforated high-density polyethylene drainage pipe will be placed within the drainage gravel to accelerate leachate transport into the LCRS sump during high precipitation events. On the lined landfill floor the drain gravel layer will be underlain by a geotextile cushion resting on the primary high-density polyethylene geomembrane. The geotextile will provide additional protection for the primary geomembrane on the floor of the landfill.

On the lined landfill sideslopes, the LCRS will have a composite drainage net (CDN) layer composed of a geonet (which is a network of HDPE strands, interwoven and bonded to form a panel that provides a drainage pathway for fluids), with a layer of geotextile thermally bonded to each side. This CDN layer will have a transmissivity of at least 3×10^{-5} meters squared per second. The CDN will be used on the sideslopes to avoid problems associated with placement of clean granular material on slopes, thereby minimizing the potential for damaging the underlying liner system.

4.3.3.1.3 Primary Geomembrane Liner

The primary geomembrane liner will act both as an impermeable leachate barrier and as a flow surface, routing leachate to the primary sump. High-density polyethylene will be used because of its high resistance to chemical deterioration. Generally, textured (roughened) geomembrane will be used to maximize shear strength along adjacent interfaces and to reduce the potential for sliding of the liner system.

4.3.3.1.4 Primary Geosynthetic Clay Liner Layer

A primary geosynthetic clay liner (GCL) will consist of a mat of bentonite placed between two geotextiles. The GCL will be installed immediately beneath the primary high-density polyethylene liner on the floor of the lined landfill only. The purpose of this liner will be to provide extra protection in the case of deterioration (such as stress cracking) of the primary geomembrane where operations will continue for several years.

The in-place hydraulic conductivity of the GCL will be 1 x 10^{-8} centimeter per second or less, exceeding the WAC hydraulic conductivity requirement for the secondary soil liners. The upper surface of GCL provides a smooth uniform surface on which to place the overlying geomembrane liner.

4.3.3.1.5 Leak Detection System

The LDS will provide the flow path for leachate flowing into the LDS sump. The following is a description of the system to be used in the IDF landfill.

The LDS will have a CDN drainage layer on the floor, and a CDN drainage layer on the sideslopes. The CDN consist of a layer of geotextile thermally bonded to each side of the geonet. These materials and their configuration will be similar to the LCRS described in Section 4.3.3.1.2, except for the absence of a drainage gravel layer and a perforated drainage pipe system on the floor of the lined landfill. The LDS will channel leachate that penetrates the primary liner system through the CDN into the leak detection sump.

The LDS serves as a secondary LCRS for the IDF. Leachate collected in the secondary sump will be measured to determine the leakage rate through the primary liner.

4.3.3.1.6 Secondary and Tertiary Geomembrane Liner

The secondary geomembrane liner, located underneath the LDS, will be placed directly against the secondary compacted admix liner, except in the LDS sump area which will include a geosynthetic clay liner between the secondary geomembrane liner and the secondary compacted admix liner. For information only, the teriary geomembrane liner for the SLDS will be placed directly against subgrade as per 4.3.3.1.8. The secondary and teriary geomembrane liners will be similar to the primary geomembrane described in Section 4.3.3.1.3. The secondary geosynthetic clay liner material will be similar to the primary geosynthetic clay liner described in Section 4.3.3.1.4.

4.3.3.1.7 Secondary Admix Liner

The secondary admix liner will have a minimum 0.9-meter-thick compacted soil/bentonite admixture located immediately beneath the secondary high-density polyethylene liner, as required by WAC 173-303-665. The secondary admix liner typically will consist of silty sand from local borrow sources mixed with a nominal 12 percent sodium bentonite, by dry weight. The in-place hydraulic conductivity of the admix liner will be 1 x 10^{-7} centimeter per second or less, consistent with WAC requirements for secondary soil liners. The upper surface of the secondary admix liner will be trimmed to the design grades and tolerances. The surface will be rolled with a smooth steel-drum roller to remove all ridges and irregularities. The result will be a smooth uniform surface on which to place the overlying geomembrane liner.

4.3.3.1.8 Subgrade/Liner System Foundation

The lined landfill in the IDF will be founded in undisturbed native soils or material compacted to at least 95 %of a standard proctor maximum density (determined by ASTM D698). The liner system foundation is discussed in further detail in Section 4.3.4.

4.3.3.1.9 Access Ramp

The lined landfill will have an access ramp outside the lined portion of the landfill, minimizing damage to the liner system from vehicle traffic into the lined landfill. As the landfill expands the access ramp will be reconstructed to the south of each expansion in the landfill. The access ramp design could vary as the landfill expands.

4.3.3.1.10 Landfill Expansion

The initial phase of the IDF liner will be complete at the north end of the landfill. As shown in Figure 4-1, construction of the first IDF phase will complete the liner system on the north sideslope and the excavated portions of the landfill floor, east sideslope, and west sideslope. The dashed line of Figure 4-1 across the south edge of the landfill floor denotes the southern extent of the landfill liner. The liner system will be installed to extend approximately 15 meters beyond the estimated toe of slope of the first phase waste placement. This extension will also allow waste haul vehicles to be staged or unloaded over a lined area. Termination detail for the south edge of the liner system is found in Appendix 4A on drawing H-2-830840. The south sideslope of the first phase of IDF is not lined to allow future expansion of the IDF. At the south end of the cells will be a storm water berm/ditch with an infiltration area, which will capture clean runoff from the unlined south sideslope before it runs onto the lined landfill. The landfill floor slopes up 1% from north to south to allow adequate leachate collection capacity for a 25 year storm event. Each future liner construction project will connect to the south edge of the previously constructed liner and operations systems and extend the disposal area further to the south. With the expansion of the IDF in subsequent phases, access ramps for the previous phase will be destroyed and new ramps built on the south edge of the landfill.

4.3.3.2 Liner System Location Relative to High Water Table [D-6c(2)]

The water table is located approximately 90 to 100 meters below the ground surface in the IDF. It is anticipated that the deepest point of the liner system will be no greater than 20 meters below ground surface. Consequently, the liner systems will be at least 69 meters above groundwater. The liner systems will not be affected by the water table because of this large elevational difference.

4.3.3.3 Loads on Liner System [D-6c(3)]

The liner system will experience several types of stresses during construction, operation, and closure/postclosure periods. The following sections discuss the types of stress and analytical methods used to design the IDF liners.

4.3.3.3.1 Liner Stress

The geosynthetic liner components will experience some stress particularly during installation and before placing waste in the lined landfill but also during the entire lifecycle. The high-density polyethylene liner will be temperature sensitive, expanding and contracting as liner temperatures increase and decrease. Thermally induced stresses could develop in the liner if deployment and anchoring occur just before a significant decrease in the liner temperature. The operations layer will be sufficiently thick to ensure liner stress remains below the yield strain and stress. Administrative procedures will prevent loading and backfilling of waste exceeding applicable thermal limits due to recent vitrification processes to avoid potential liner damage.

The drainage gravel will have the potential to produce localized stress on the geomembrane liner during gravel placement with construction equipment. A geotextile cushion will be placed at the base of the drainage gravel to protect the underlying geomembrane. A puncture analysis was performed to select a sufficiently thick cushion geotextile. This analysis incorporated expected construction vehicle ground pressures and design drainage gravel gradation listed in the construction specifications. If required, engineering controls such as independent foundations will be installed to minimize liner stress involved with large package disposal.

On the landfill sideslopes, tension induced by liner-component load transfer is not anticipated, because the liner interface effective shear strength angles will be higher than the sideslope angles. The liner component interface strengths were determined by laboratory direct shear tests. Both static and dynamic stability analyses were performed, using standard methods, design accelerations, and factors of safety.

Stress on the geomembrane in the anchor trench also were evaluated during detailed design. Wind uplift and thermal expansion and contraction could cause stress in the geomembrane during construction. However, these stresses will not be a problem, because the stress will be relatively low as compared to the tensile strength of the liner. In addition, these stresses are minimized by using sand bags to control liner position during liner panel placement and welding, as well as keeping the anchor trench open until the liner is stabilized with overlaying fill material. Placement of overlaying fill material is controlled to limit stress buildup in the liner. The stress will not be present after construction, because of the weight and insulating properties of the operations layer.

4.3.3.3.2 Stress Resulting From Operating Equipment

Operations equipment provides a design load case on the IDF liner, which was analyzed as part of the IDF design (refer to Appendix 4-A). The analyses show that the 0.9-meter-thick operations layer will dissipate stress produced by the operating equipment and is sufficient to protect the IDF liner system.

4.3.3.3.3 Stress From Maximum Quantity of Waste, Cover, and Proposed Closure/Postclosure Land Use

When the lined landfill is full and the cover system is in place, the liner system will experience a static load from the overlying waste, backfill, and cover materials. No significant increase in stresses on the liner system is anticipated from closure/postclosure land use. The maximum design load of material overlying the liner system includes an allowance for the cover system. Analyses include puncture protection of the geomembrane by the cushion geotextile, and decrease in transmissivity of CDN drainage layers. Materials were specified based on the ability of the materials to perform adequately under closure/postclosure loading conditions.

Dynamic stress on the liner system will result primarily from ground accelerations during seismic events. Both static and dynamic analyses were performed on the subgrade and liner components based on the finished configuration of the empty landfill. Under closure/postclosure conditions, the waste, backfill, and cover materials will tend to buttress the liner system, resulting in greater stability relative to the operational phase. All of the analyses verified adequate stability for the IDF.

4.3.3.3.4 Stresses Resulting From Settlement, Subsidence, or Uplift

The subgrade settlement produced by waste loading essentially will be elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade will rebound during the excavation phase of construction and will settle as the landfill is filled. The compacted admix liner will consolidate under waste loads. The total settlement will be a combination of the subgrade elastic and the admix consolidation settlements. These settlements were analyzed with standard methods during detailed design of the lined landfill. In general, differential settlements will be expected to occur primarily across the lined landfill sideslopes as the thickness of waste decreases from maximum to zero. The geosynthetic liner components were analyzed, the anticipated strains likely will not produce any appreciable stresses in the liner system.

The potential for subsidence-induced stress is believed to be negligible based on the following information:

- The soils underlying the IDF tend to be coarse-grained soils, sands and gravels, in a relatively dense configuration that will not be subject to piping effects that could transport soil resulting in subsidence.

- The groundwater level will be deep, at least 69.6 meters below the base of the lined landfill, and will not affect bearing soils.
- No natural voids, or man-made mining or tunneling has been noted. If the groundwater level was lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater below the lined landfill.

The potential for stresses resulting from uplift on the liner system also is expected to be negligible. The seasonal groundwater level is very deep, and higher-elevation perched groundwater likely will not develop because of the absence of aquitards in the coarse-grained Hanford formation underlying the IDF. The coarse-grained nature of the Hanford formation also promotes rapid, primarily vertical, infiltration, which means it is unlikely that infiltration from outside the lined landfill boundary would be transported laterally underneath the landfill liner. Gas pressures similarly are unlikely to develop because of the absence of any organic material that could generate significant subsurface gas (from organic material decomposition) and the coarse-grained, highly permeable sands and gravels underlying the landfill.

4.3.3.3.5 Internal and External Pressure Gradients

Pressure gradients across the liner caused by liquids or gases will be expected to be negligible. Internal pressures due to liquids will be controlled by the leachate collection and removal system. Because leachate will be removed from the flat 50-foot by 50-foot LCRS sump in a timely manner, there will be minimal liquid head on the liner (less than 30.5 centimeters according to WAC regulations). Gas generated internally is expected to be minimal because waste is inorganic and non-reactive. However any pre-closure internally generated gas will be vented either through the waste or the leachate collection system. The closure cover design will consider gas venting.

External pressures on the liner system will be expected to be minimal. Gas pressures will be negligible because the subgrade soil contains no gas producing materials and is highly permeable, readily venting any potential gas to the atmosphere. External pressure from liquids will not be anticipated because of the deep groundwater table and the highly permeable foundation soils.

4.3.3.4 Liner System Coverage [D-6c(4)]

The liner system will cover all soils underlying the lined landfill and extends over the crest of the sideslopes into the anchor trench (Figure 4-2, Detail 3).

4.3.3.5 Liner System Exposure Prevention [D-6c(5)]

No geosynthetic or admix components of the liner system will be exposed to the atmosphere. The minimum 0.9-meter-thick operations layer will cover the entire lined landfill surface. This layer will serve both as a physical protective barrier and as thermal insulation, protecting the admix layer from desiccation and frost damage.

Excessive erosion, such as gullying, will be repaired by replacing the eroded soil. Dust suppression agents will be used to prevent excessive wind erosion on the landfill sideslopes. The dust suppression agents will bind the surface of the operations layer and will minimize wind entrainment of soil.

4.3.4 Liner System, Foundation [D-6d]

The following sections discuss the foundations beneath the liner systems.

4.3.4.1 Foundation Description [D-6d(1)]

At the IDF, the Hanford formation consists mainly of sand dominated facies with lesser amounts of silt dominated and gravel dominated facies. Where sands are present, these sands are underlain by the

Hanford formation. Here, the Hanford formation has been described as poorly sorted pebble to boulder gravel and fine to course grained sand, with lesser amounts of interstitial and interbedded silt and clay.

The two geologic units pertinent to the IDF lined landfill are summarized as follows.

Recent eolian sand: The sand is light olive gray in color and has a density that is loose at the surface but becomes compact with depth. The sand has a fine to medium grain size and includes little to some nonplastic silt-sized fines. The deposit is homogeneous except for a distinguishable layer of volcanic ash in some locations.

Glaciofluvial flood deposit: This deposit has well graded mixtures of sands and gravels with trace to little nonplastic silt-sized particles. The gravel content can vary with depth, and the deposit can become predominantly gravel. This coarse-grained deposit is part of the Cold Creek Bar, which was formed during the Pleistocene Epoch by glacial outburst flooding.

4.3.4.2 Subsurface Exploration Data [D-6d(2)]

Geological site investigations were used to support the detailed design of the landfill. The investigations consisted of a review of historical data, including well logs (Chapter 5.0), exploratory borings, and surface pit samples data. Because the foundation soils are relatively consistent over broad areas, the need for additional borings and geophysical investigations will be determined on a case-by-case basis. If boreholes are drilled, penetration test data will be collected to determine the strength of the foundation materials in situ.

4.3.4.3 Laboratory Testing Data [D-6d(3)]

Laboratory testing will be performed on the surface soil samples and borings, both from the lined landfill site and from potential borrow source locations as follows. Testing will be performed to classify soils, provide input parameters to verify engineering analyses, and for preparing material and construction specifications. The following tests will be performed on the soil samples:

- Visual classification (ASTM D2487)--to classify soils
- Natural moisture content (ASTM D2216)--for input to engineering analyses and preparing construction specifications
- Particle size analysis (ASTM D422 or D1140/C136)--for classification and input to engineering analyses
- Moisture-density relationships (ASTM D698 or D1557)--for preparing compaction specifications

Laboratory testing will be performed according to the most recent versions of ASTM methods or other recognized standards. Additional tests will be performed as needed.

4.3.4.4 Engineering Analyses [D-6d(4)]

The subgrade will be required to support the liner system and overlying materials (waste, fill, and cover) without excessive settlement, compression, or uplift that could damage the liner system. This section describes the design approach used to satisfy these criteria.

4.3.4.4.1 Settlement Potential [D-6d(4)(a)]

The subgrade settlement produced by waste loading essentially will be elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade will rebound during the excavation phase of construction and will settle as the landfill is filled. An elastic settlement analysis using standard methods was performed and results indicate the magnitude of the total and differential settlement is within performance limits.

4.3.4.4.2 Bearing Capacity [D-6d(4)(b)]

The bearing capacity of the subgrade soil will need to support structures such as leachate collection tanks. The construction specifications typically will require that the upper portion of the subgrade soil and all structural fill be moisture conditioned and compacted to at least 95 percent of the maximum standard Proctor dry density (ASTM D698). Maximum allowable bearing capacities for foundations have been established using standard geotechnical methods. Bearing capacities for the types of soils expected at the IDF typically are greater than the maximum expected loads from the support structures.

4.3.4.4.3 Stability of Lined Landfill Slopes [D-6d(4)(c)]

The lined landfill will be constructed in eolian sand and the underlying coarse-grained Hanford formation. In granular, cohesionless, and drained soils such as these, the stability of the slope will be related primarily to the maximum slope angle. Both veneer and global stability analyses were performed to determine both static and dynamic sideslope stability. Results demonstrate adequate stability for the IDF throughout its design life.

4.3.4.4.4 Potential for Excess Hydrostatic or Gas Pressures [D-6d(4)(d)]

Because the seasonal high-water level is at least 69 meters below the base of the deepest lined landfill, no external hydrostatic pressure will be expected from this source. Because of the coarse-grained nature of the foundation soils, any infiltration of surface water around the perimeter of the lined landfill will be expected to travel primarily downward. Therefore, infiltration should not cause substantial pressure on the exterior of the liner system. Internal hydrostatic pressure from leachate will be negligible because the leachate will be removed from the lined landfill to limit head on the liner.

Gas pressure exerted externally on the liner system is expected to be negligible, because no gas-generating material (i.e., organic material) is expected in the foundation soils. If any gas were generated below the liner system, little pressure buildup would occur because of the unsaturated coarse-grained nature of the foundation soils, which would vent the gas to the atmosphere. Internal gas pressure buildup will not be anticipated, because wastes are generally inorganic and have low gas generating potential, and the leachate collection system will be vented to the atmosphere and dissipates any gas.

4.3.4.4.5 Seismic Conditions

Potential hazards from seismic events will include faulting, slope failure, and liquefaction. Disruption of the lined landfill by faulting is not considered a significant risk because (1) no major faults have been identified at the IDF (DOE/RW-0164) and (2) only one central fault at Gable Mountain on the Hanford Site shows evidence of movement within the last 13,000 years. The potential for slope failure is considered low, because granular materials typically have high strengths relative to the maximum sideslope angles expected for the lined landfill. Liquefaction will occur in loose, poorly graded granular materials that are subjected to shaking from seismic events. Saturated soils will be most susceptible because of high dynamic pore pressures that temporarily lower the effective stress. During this process, the soil particles will be rearranged into a more dense configuration, with a resulting decrease in volume. The foundation materials at the IDF is not considered susceptible to liquefaction because the materials are well graded granular soils that are unsaturated and relatively dense.

The IDF support building (not sited within the TSD boundary) will be located in Zone 2B as identified in the Uniform Building Code (ICBO 1997).

4.3.4.4.6 Subsidence Potential

In general, subsidence of undisturbed foundation materials would be the result of dissolution, fluid extraction (water or petroleum), or mining. The potential for subsidence will be negligible at the IDF based on the following.

- The soils underlying the IDF are coarse-grained sands and gravels, in a relatively dense configuration which are not subject to piping that can cause transport of soil and resulting subsidence.
- The groundwater level is deep, at least 69 meters below the base of the lined landfill, and does not affect bearing soils.
- The soil and rock types below the IDF are not soluble.
- No mining or tunneling has been noted. If the groundwater level was lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater table below the lined landfill.

4.3.4.4.7 Sinkhole Potential

Borings in and around the IDF have not identified any soluble materials in the foundation soils or underlying sediments. Consequently, the potential for any sinkhole development is negligible.

4.3.5 Liner System, Liners [D-6e]

The following sections discuss the individual components of the IDF liner systems.

4.3.5.1 Synthetic Liners [D-6e(1)]

As described in Section 4.3.3, the synthetic liners will act as an impermeable barrier for leachate migration (Figure 4-2). The synthetic liners will consist of high-density polyethylene material that will make the liners resistant to chemical deterioration. Section 4.3.3 describes the synthetic liner system in greater detail.

4.3.5.2 Synthetic Liner Compatibility Data [D-6e(1)(a)]

During detailed design of the lined landfill, the composition of the expected leachate was estimated. Expected leachate composition was based on known waste composition, process information, leachate from other operating lined landfills, and similar sources of data. Leachate constituents were compared to manufacturers' chemical compatibility data for synthetic liner components. In addition, the results of previous chemical compatibility testing and studies were evaluated against leachate composition. Information gained from this evaluation was used to select a liner that will be compatible with the expected leachate.

Compatibility testing for leachate tank liner material is planned for construction. An immersion test program is included in the technical specifications for the tank liner (anticipated to be XR-5 material). The immersion testing program will require the construction general contractor to submit tank liner samples to the design engineer for immersion testing as part of the submittal and certification process for the tank. Immersion testing will follow EPA 9090A (and ASTM) test protocols.

During landfill operation, the compatibility of waste receipts with the liner will be ensured. The compatibility of the waste constituents with the liner material will be established by laboratory testing if determined to be necessary, based on waste type and concentrations. Such tests will follow EPA Method 9090A or other appropriate methods. Test results will be evaluated using statistical methods and accepted criteria (based on past projects and agency acceptance) for liner/leachate compatibility.

4.3.5.3 Synthetic Liner Strength [D-6e(1)(b)]

As discussed in Section 4.3.3.3, the liner system will experience loads from several sources. During the detailed design process for the landfill, the strength of liner system materials was evaluated against these loads. The analysis indicated an adequate factor of safety for liner system materials.

Seams in geomembranes will be a critical area. However, with correct installation methods, the seams will be stronger than the surrounding material. Detailed installation and testing requirements will be included in the construction quality assurance plan (Section 4.3.7.3) to ensure that the liner is constructed properly. In addition, methods will be established to demonstrate adequate seam strength is achieved during installation.

Seaming requirements for the geotextilesand CDN will not be as stringent. These materials will be overlapped sufficiently to provide complete area coverage, and relatively light seams will be used to hold the panels in position during construction. After the lining system has been completed, seam strength requirements for these materials will be negligible.

4.3.5.4 Synthetic Liner Bedding [D-6e(1)(c)]

The primary geomembrane liner will be in contact with the GCLand geotextile cushion underlying the drainage gravel.

The secondary geomembrane liner will be in direct contact with the compacted admix layer. This type of subgrade is typical for flexible geomembrane liners. No problems related to the mechanical integrity of the geomembrane liner will be expected in this application.

With respect to the drainage gravel and operations layers, the geomembranes will be protected by overlying geotextile cushion or CDN layers. These geotextiles were designed to provide adequate protection during construction and operation to withstand the loads discussed in Section 4.3.3.3.

4.3.5.5 Soil Liners [D-6e(2)]

The IDF landfill will be lined with a minimum (0.9-meter thick) layer of compacted soil/bentonite mixture (admix) under the secondary geomembrane liner. This layer will have an in-place hydraulic conductivity of less than 1×10^{-7} centimeter per second. The soil component of the admix will be silty fine sand or similar material from areas near the IDF. Approximately 12 percent bentonite by dry weight will be added to the fine soil to achieve sufficiently low hydraulic conductivity; however, the percent might vary. Construction of the liner is discussed in Section 4.3.7.

4.3.5.5.1 Material Testing Data [D-6e(2)(a)]

Laboratory testing will be performed on soil liner materials to confirm input parameters for engineering analyses and for refining material and construction specifications.

Before constructing the lined landfill, a full-scale test fill of the admix material will be conducted. The primary purpose of the test fill will be to verify that the specified soil density, moisture content, and hydraulic conductivity values will be achieved consistently using proposed compaction equipment and procedures. In-place density will be measured using both the nuclear gauge (ASTM D2922) and sand cone (ASTM D1556) methods. In-place hydraulic conductivity will be determined from a two stage infiltration from a borehole (ASTM D6391). Admix hydraulic conductivity will be estimated from thin-wall tube samples (ASTM D1587) obtained from the test fill and tested in the laboratory (ASTM D5084). Details of the test fill are presented in the Construction Quality Assurance Plan (Appendix 4B). During construction, field density (e.g., ASTM D2922, D2167, and/or D1556) and moisture content (ASTM D2216) will be measured periodically. Thin-wall tube samples (ASTM D1587) will be taken at regular intervals and will be tested for hydraulic conductivity (ASTM D5084). Additional details of field testing during construction will be presented in the Construction Quality Assurance Plan.

Dispersion and piping in the admix are not considered likely because the hydraulic conductivity, and thus the flow velocity, will be very low, making it difficult to move the soil particles or otherwise disrupt the soil fabric. In addition, the admix will be well graded, so the component particles will tend to hold each other in place. Therefore, testing for these characteristics will not be necessary.

4.3.5.5.2 Soil Liner Compatibility Data [D-6e(2)(b)]

As discussed in Section 4.3.5.2, expected leachate composition was determined as part of detailed landfill design. The results of previous chemical compatibility testing and studies were evaluated against leachate composition to determine the effect of leachate on soil liner composition or hydraulic conductivity. The tests followed the procedures of ASTM D5084 (flexible wall parameter) and considered the effects of radiation on the soil liner materials.

4.3.5.5.3 Soil Liner Thickness [D-6e(2)(c)]

The IDF has been designed and will be operated to minimize the leachate head over the liner systems. Design of the primary liner system has included an additional clay layer (the primary GCL layer, which was previously described in Section 4.3.3.1) underlying the primary HDPE geomembrane to further minimize liner leakage from the primary liner. Note that only a single geomembrane is required under WAC 173-303 for the primary liner.

Calculations were performed to evaluate the effectiveness of the primary soil liner as a barrier to leachate. Leakage analyses were performed for the primary liner system using EPA's Hydrologic Evaluation of Landfill Performance (HELP) Model (Schroeder et al. 1997). Estimated leakage rates were compared to the Action Leakage Rate (ALR, which is defined in WAC 173-303-665[8] as "the maximum design flow rate that the leak detection system … can remove without the fluid head on the bottom liner exceeding 1 foot"), and were determined to be much lower than the ALR. This demonstrates the benefit of the GCL included in the primary bottom lining system, which provides a composite lining system and minimizes actual leakage through the bottom primary lining system.

Overall, the IDF is designed to actively convey and collect leachate from the liner areas of the facility to minimize leachate buildup over the liners. Leachate is conveyed to the LCRS and LDS sumps for active removal from the facility. In addition, the LCRS sump area has been designed with a 6-inch-deep sump trough where the LCRS pumps are positioned to minimize the area of the sump that has a permanent liquid level (below the pump intake/shutoff elevation). Both the LCRS and LDS sump pumps will be operated throughout the active life of the facility and into the post-closure time period until leachate generation has essentially ceased. By actively removing leachate from the IDF, head buildup is minimized, which in turn minimizes leakage through both the primary and secondary liner systems.

4.3.5.5.4 Soil Liner Strength [D-6e(2)(d)]

The expected loads on the liner system are discussed in Section 4.3.3.3. Significant stresses in the soil liner that were considered include (1) stresses from the weight of the liner system, (2) stresses on the interface with the overlying materials, and (3) stresses during construction.

Stresses will be present on the sideslopes from the weight of the operations layer and soil liner itself. Using material properties determined from laboratory testing, the stability of the soil liner were evaluated under both static and dynamic loading conditions. Standard methods of slope stability analysis were used. Interface strengths were found to provide adequate veneer stability for the liner system. Interface strength is the shear strength that occurs between layers of liner materials at their interface boundary, as established by ASTM test methods.

The primary concern during construction will be bearing failure caused by the weight of overlying soil components of the liner system (e.g., drainage gravel on the floor) and the construction equipment used to spread these materials. Strength parameters developed from laboratory testing and standard analytical methods were again used to determine that adequate stability and bearing capacity exist for the IDF liner system.

4.3.5.5.5 Engineering Report [D-6e(2)(e)]

An engineering report was prepared for the lined landfill as part of the definitive design document package. The report describes the design of the liner system and includes supporting calculations. The critical systems IDF Design Report is provided in Appendix 4A. The final IDF design report was prepared under the supervision of a professional engineer registered in Washington State.

4.3.6 Liner System, Leachate Collection and Removal System [D-6f]

The purpose of the leachate collection and removal system will be to provide sufficient hydraulic conductivity and storage volume to collect, retain, and dispose of, in a timely manner, fluids falling on or moving through the waste. The primary leachate collection and removal system will provide the preferential path along which the leachate will flow into the primary sump. The secondary leachate collection and removal system (also called the leak detection system) will be located between the primary and secondary geomembranes. The secondary leachate collection and removal system will provide the preferential path along which any fluids leaking through the primary liner system flow to the secondary sump.

The collected leachate will be pumped to a leachate collection tank, screened and/or sampled, and transferred to a permitted treatment and disposal unit.

4.3.6.1 System Operation and Design [D-6f(1)]

The lined landfill will be operated in a way that ensures the bottom liner is maintained as dry as possible, and the head on the top liner does not exceed 30.5 centimeters measured above the flat 50-foot by 50-foot LCRS sump HDPE liner. In extreme conditions (i.e., in excess of a 25-year storm event), the head on the top liner could exceed 30.5 centimeters for short durations. The operating methodology, described in the following paragraphs, will ensure that liquids on the bottom liner are removed continuously before liquids could accumulate and exceed 30.5 centimeters for the design storm event.

Both leachate collection systems either will be operated manually or automatically. When operated automatically, liquid level sensors will cycle the pumps on and off, in response to rising and falling leachate levels. The leakage rate through the top liner will be calculated to demonstrate that the leakage rate is less than the 'action leakage rate'. Data to support the leakage rate calculations will be obtained either from the flow totalizer in the secondary leachate collection pump discharge line or from the liquid level gauges. Collected leachate from the secondary leachate collection system will be pumped to the leachate collection tank.

The design of the primary and secondary leachate collection systems is described in Section 4.3.3.1. System geometry was completed and material specifications were developed during the detailed design process. The leachate collection and removal system design will comply with WAC 173-303 requirements and applicable guidance.

Each sump will have a thick layer of gravel designed to provide high hydraulic conductivity and storage capacity. Leachate will be removed from the sumps by a pump installed in sideslope riser pipes. Pressure transducers will be used to monitor leachate level in the sumps and will provide appropriate signals to the pump control system. All pumps and transducers will be removable for maintenance, calibration, and related activities.

4.3.6.1.1 Primary System

The base of the leachate collection and removal system will be defined by the primary geomembrane. On the floor of the lined landfill, the primary geomembrane will be overlain by geotextile cushion, and the granular drainage layer. The granular drainage layer will drain to the primary sump and a perforated pipe will be located along the centerline of the cell to increase flow capacity to the primary sump. Geotextile layers at the top of the leachate collection and removal system will prevent migration of fine soil particles into the gravel or geonet, thus prevent clogging. On the sideslopes, a CDN layer will be used over the geomembrane. The CDN will include bonded geotextiles on both sides of a geonet that increase the interface shear strength. Because of construction difficulties in placing a 30.5-cm thick gravel layer on 3:1 sideslopes, no drainage gravel will be placed on the sideslopes.

The leachate collection and removal system will be covered by the operations layer. The layer will be a minimum 0.9-meter thick, and will provide protection for the underlying liner and drainage materials. The operations layer will cover both the landfill floor and the sideslopes.

The leachate collection and removal system will be designed to accommodate the 25-year, 24-hour storm, as required by WAC regulations. However, the EPA recognizes the need to temporarily store leachate from such rare events (EPA 1985). Should a storm event that exceeds the 25-year, 24-hour storm event occur, the leachate collection and removal system sump was designed to temporarily store leachate at a depth greater than 30.5 centimeters, as opposed to the alternative of constructing an excessively large leachate collection tank.

The leachate collection and removal system sump will be equipped with two sump pumps. One pump will be a high capacity pump capable of rapid removal of large volumes of leachate, will be suitable for the transfer of batch quantities of leachate, and will handle the larger volumes of leachate anticipated from the 25-year, 24-hour storm event. The other pump will be a low-capacity submersible pump located in the base of the sump. The sump pumps will be located in a sump trough. The sump trough was designed to contain the leachate below the intake of these pumps, within the smallest possible area, to minimize the residual leachate volume after each pumping cycle. The pumps will be fabricated from stainless steel or other corrosion resistant material.

4.3.6.1.2 Leak Detection System

The base of the LDS will be formed by the secondary geomembrane. The leak detection system will be similar to the LCRS, except that the perforated collection pipe is not included. The perforated pipe will not be needed because high flow capacity will not be required for the low leachate volumes.

The LDS will drain to the LDS sump, which will be located immediately below the LCRS sump. Because of the low volumes, the LDS will be equipped with only one low-capacity submersible pump to meet WAC 173-303-665(8)(a).

4.3.6.1.3 Response Action Plan

In compliance with regulatory requirements, a response action plan (Appendix 4C) was prepared for the lined landfill. In accordance with EPA guidance, the action leakage rate was calculated as "the maximum design flow rate that the leak detection system can remove without the fluid head on the bottom liner exceeding 30.5 centimeters" (EPA 1992). If the action leakage rate were exceeded, DOE will do the following:

- Notify the appropriate regulatory authority in writing of the exceedence within 7 days of the determination

- Submit a preliminary written assessment to the appropriate regulatory authority within 14 days of the determination, on the amount of liquids, likely sources of liquids, possible location, size, cause of any leaks, and short-term actions taken and planned
- Determine to the extent practicable the location, size, and cause of any leak
- Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether the unit should be closed
- Determine any other short-term and/or long-term actions to be taken to mitigate or stop any leaks
- Within 30 days after the notification that the action leakage rate has been exceeded, submit to the appropriate regulatory authority the results of the analyses specified in the following paragraphs, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, DOE will submit to the appropriate regulatory authority, a report summarizing the results of any remedial actions taken and actions planned.

The leachate will be analyzed for RCRA constituents as appropriate. A procedure will be in place to address details of analysis (i.e., analyses, constituents, test methods, etc.). If the analytical results on leakage fluids indicate that these constituents are present, and if the constituents can be traced to a particular type of waste placed in a known area of the lined landfill, it might be possible to estimate the location of the leak. In addition, waste packages might not undergo enough deterioration during the active life of the landfill to permit escape of the contents; it is possible that the leachate might be clean or the composition too general to show a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the landfill. Backfill would need to be removed from around any waste packages to accomplish this. If the waste packages were damaged during this process, the risk of accidental release might be high. For these reasons, large-scale removal of waste and liner system materials will not be a desirable option and will not be implemented except as a last resort.

The preferred alternative will depend on factors such as the amount of waste already in the landfill, the rate of waste receipt, the chemistry of the leachate (i.e., is it clean?), the availability of other disposal units, and similar considerations. Therefore, no single approach will be selected at this time. If necessary, an interim solution could be implemented while the evaluation and permanent remediation were performed. Examples of potential approaches include the following.

- The surface of the waste could be graded to direct run-off into a shallow pond. The surface would be covered with the low-hydraulic conductivity layer (geomembrane). Precipitation would be pumped or evaporated from the pond and would not infiltrate the waste already in the lined landfill. Waste would be placed only during periods of dry weather, and stored at other onsite TSD units at other times. This type of approach also could be used to reduce leakage immediately after the action leakage rate was exceeded, while other remediation options were evaluated.
- Partial construction of the final closure cover could begin earlier than planned. This would reduce infiltration into the lined landfill, and possibly reduce the leakage rate if the cover were constructed over the failed area.
- A layer of low-hydraulic conductivity soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second 'primary' liner higher in the lined landfill. This new liner would intercept precipitation and allow its removal.

- A rigid-frame or air-supported structure could be constructed over the landfill to ensure that no infiltration occurs. Although costly, this approach could be less expensive than constructing a new landfill.

In general, the selected remediation efforts will be progressive. Those remediation methods that are judged to be the least difficult and the most cost effective will be used first. If these efforts are not effective, more difficult or expensive options would be used.

4.3.6.2 Equivalent Capacity [D-6f(2)]

The CDN drainage layers used will be available commercially and will have equivalent flow capacity to a 30.5-centimeters layer of granular drainage material with a hydraulic conductivity of 1×10^{-2} centimeter per second.

4.3.6.3 Grading and Drainage [D-6f(3)]

In accordance with EPA guidance, all areas of the lined landfill floor (except the sump bottoms) will be graded at a slope of at least 2 percent towards the centerline of each cell. The centerline of each cell will have a 1 percent slope lengthwise towards the sump, to facilitate drainage and avoid ponding on the liners. Grading tolerances have been established to ensure proper slope is maintained.

4.3.6.4 Maximum Leachate Head [D-6f(4)]

The maximum head on the primary liner will be less than 30.5 centimeters, except for rare storm events as discussed in Section 4.3.6.1 and the LCRS sump trough. The sump was sized and designed to provide adequate surge storage to prevent leachate build up on the primary liner.

4.3.6.5 System Compatibility [D-6f(5)]

The primary and secondary leachate collection and removal systems will be composed of inert geologic materials (sand and gravel), high-density polyethylene, and other geosynthetic materials such as polypropylene. As described in Section 4.3.5.2, the geosynthetics were evaluated for compatibility with the expected leachate. To ensure that the geosynthetics used in the lined landfill are similar chemically to those evaluated, manufacturers will be required to submit quality control certificates and other manufacturing information on all materials.

Before a new waste constituent, not previously analyzed (based on a dangerous waste number), is allowed in the lined landfill, the waste constituent will be evaluated for compatibility with the liner (e.g., identified in 9090A test results or other appropriate testing methods, etc.). Other materials could contact the leachate, for example:

- HDPE and Polyvinyl chloride (PVC) piping will be used
- Polyvinyl chloride and other plastics in miscellaneous uses
- Leachate tank will use a chemically resistant flexible geomembrane liner system.

Compatibility of these materials with the expected leachate was considered in the landfill liner system design. Compatibility of these materials will be of lesser concern, because items that consist of these materials will be located entirely within the containment area. Failure of these items would not result in a dangerous waste release, and the materials would be replaced or repaired.

4.3.6.6 System Strength [D-6f(6)]

Stability of drainage layer, strength of piping, and prevention of clogging are discussed in the following sections.

4.3.6.6.1 Stability of Drainage Layers [D-6f(6)(a)]

As described in Sections 4.3.3.3 and 4.3.5.3, the stability of the liners and leachate collection and removal systems on the sideslopes was evaluated as part of detailed design (Appendix 4A). To provide sufficiently high shear strengths at the interfaces between geosynthetic components, textured geomembranes and thermally bonded CDNs are used.

Bearing capacity of the drainage and sump gravels is expected to be adequate, based on typical strength values for granular materials.

The transmissivity of the drainage layers under the combined load of the waste and cover was addressed in the design and will be adequate to support leachate removal.

4.3.6.6.2 Strength of Piping [D-6f(6)(b)]

The drain pipes in the primary drainage and sump gravel and sideslope riser pipes will be high-density polyethylene pipe. During detailed design, the required wall thickness of the pipe was determined according to the manufacturer's recommendations and standard analytical methods used by the piping industry (Appendix 4A). In these analyses, the ultimate load (derived from the estimated weight of the waste and cover) was used, the allowable deflections were limited to 5 percent, and conservative values for soil modulus and lateral confinement were assumed.

4.3.6.7 Prevention of Clogging [D-6f(7)]

The geotextiles that separate the drainage layers from adjacent soil layers was selected based on the ability of the geotextiles to retain the soil and to prevent the soil from entering the leachate collection and removal systems. In addition, the amount of fine material in the drainage and sump gravels will be limited by specification to less than a few percent, and will not be expected to cause clogging problems (Appendix 4A). Because the waste disposed in the lined landfill will be required to satisfy LDR (RCW 70.105.050(2), WAC 173-303-140, and 40 CFR 268), the amount of organic material will be minimal, and consequently biologic clogging will not be a problem.

4.3.7 Liner System, Construction and Maintenance [D-6g]

Details relating to the liner system construction and maintenance are discussed in the following sections.

4.3.7.1 Material Specifications [D-6g(l)]

Material specifications are provided in the following sections for each of the materials used in the liner system.

4.3.7.1.1 Synthetic Liners [D-6g(1)(a)]

As described in Section 4.3.3.1, both the primary and secondary geomembrane liners will consist of high-density polyethylene. As described in Section 4.3.3.1.4, the primary barrier also contains a geosynthetic clay liner placed on the floor area only. Detailed specifications were prepared for the lined landfill as part of the design process.

4.3.7.1.2 Soil Liners [D-6g(1)(b)]

As described in Section 4.3.3.1, the soil liner will consist of imported bentonite (expansive clay) blended with fine soil deposits on or next to the IDF. The fine soil will be free of roots, woody vegetation, rocks greater than 2.54 centimeter in diameter, and other deleterious material. The bentonite content will depend on the characteristics of the fine soil. Mixing will be performed under carefully controlled conditions in a pugmill or other approved alternatives. The admix will be placed and compacted to achieve an in-place hydraulic conductivity of 1×10^{-7} centimeter per second or less. The final surface of the soil liner will be rolled smooth before placing the overlying geomembrane. Additional specifications were prepared for the lined landfill as part of the design process.

4.3.7.1.3 Leachate Collection and Removal System [D-6g(1)(c)]

Drainage and sump gravel will consist of hard, durable, rounded to subrounded material. The gravel will be washed and the amount of fine material (i.e., passing the number 200 sieve) will be limited to a few percent. The hydraulic conductivity of the gravel will be 1×10^{-2} centimeter per second or greater. Additional specifications were prepared as part of the design process.

For geotextiles and geonets, the composition, thickness, transmissivity, unit weight, apparent opening size, strength, and other properties were determined during detailed design based on results of engineering analyses, experience, and industry standard approaches.

4.3.7.2 Construction Specifications [D-6g(2)]

Construction requirements for major components of the lined landfill are summarized in the following sections.

4.3.7.2.1 Liner System Foundation [D-6g(2)(a)]

The excavated subgrade surfaces will be moisture conditioned and compacted as required to achieve the specified compaction before placing the admix layer.

4.3.7.2.2 Soil Liners [D-6g(2)(b)]

The soil and bentonite will be blended thoroughly and moisture conditioned so that the admix will be uniform and homogeneous throughout. The admix layer will be placed in loose lifts and compacted so that the compacted lift meets the requirements of the Construction Quality Assurance Plan. Each new lift of admix will be kneaded into the previously placed lift. The methods for admix preparation, type of compaction equipment, number of passes, and other details of the placement process will be determined by constructing a test fill section before placing admix in the lined landfill.

4.3.7.2.3 Synthetic Liners [D-6g(2)(c)]

To protect the overlying geomembranes, the admix surface will be smooth and free of deleterious material. In all cases, the high-density polyethylene liner will be deployed with the length of the roll parallel to the slope. Adjacent panels will be overlapped and thermally seamed using fusion or extrusion methods. Seams will be inspected continuously using air pressure tests. A vacuum box will be used in areas where air pressure tests cannot be used (e.g., extrusion weld areas). Destructive seam tests (ASTM D4437) (peel and adhesion) will be performed on samples taken at regular intervals. Placing the overlying geosynthetic layers when practicable will protect the geomembranes.

4.3.7.2.4 Leachate Collection and Removal Systems [D-6g(2)(d)]

Drainage and sump gravel will be placed and spread carefully over the underlying geosynthetics using suitable equipment to prevent damage. Hauling and placing equipment will operate on a minimum thickness of soil above any geosynthetic layer to avoid damage. Geosynthetic layers in the leachate collection and removal system will be deployed, overlapped, and joined (e.g., tying for geonets, sewing for geotextiles) according to standard industry practice and the manufacturers' recommendations. Drainage and riser pipes will be installed in the landfill. Pipes will be bedded carefully and the landfill will be backfilled to provide adequate lateral support. Pumps and other mechanical components will be installed according to manufacturers' recommendations.

4.3.7.3 Construction Quality Control Program [D-6g(3)]

A construction quality assurance plan (Appendix 4B) will be used during lined landfill construction and establishes in detail the following in accordance with WAC 173-303-335:

Program must include observations, test, and measurements to ensure

- proper construction of all components of the liners, leachate collection and removal system,
- conformity of all materials used in the design.

4.3.7.4 Maintenance Procedures for Leachate Collection and Removal Systems [D-6g(4)]

The accessible components of the leachate collection and removal system will be maintained according to preventive maintenance methods. These methods will require periodic testing to prove that the equipment, controls, and instrumentation are functional and are calibrated properly. Testing intervals will be derived from applicable regulations and manufacturer's recommendations. All pumps and motors will be started or bumped monthly or at intervals suggested by the manufacturer; first, to demonstrate that the pumps and motors are functional, and second, to move the bearing(s) so that the bearing surfaces do not seize or become distorted. Instruments will be calibrated annually or at intervals suggested by the manufacturer. When applicable, the preventive maintenance methods will include calibration instructions. The following instruments will require annual calibration:

- LCRS sump level indicator
- LDS sump level indicator

Other instrumentation inside the leachate handling and storage facilities will also require routine maintenance.

4.3.7.5 Liner Repairs During Operations [D-6g(5)]

Because of the 0.9-meter-thick operations layer, damage to the liner system is not expected. If damage did occur, the operations layer could be removed laterally as far as required. Underlying geosynthetic and gravel layers will be removed until an undamaged layer is encountered. The damaged layers will be repaired and replaced from the lowest layer upwards using similar methods to those employed during construction. Most repairs to the geomembranes will be performed using a patch, which will be placed, welded, and tested by construction quality assurance personnel.

4.3.8 Run-On and Run-Off Control Systems [D-6h]

Because of the sandy soils, small drainage area, and arid climate at the IDF, stormwater run-on and run-off will not be expected to require major engineered structures. Interceptor and drainage ditches will be adequate for run-on and run-off control. The 25-year, 24-hour precipitation event was the design storm used to size the lined landfill systems. Beyond this, surface water evaluation is highly site-specific, and appropriate analyses were performed as part of detailed design for the lined landfill.

4.3.8.1 Run-On Control System [D-6h(l)]

Run-on will be controlled by drainage ditches or berms around the perimeter of the lined landfill. Any overland flow approaching the landfill will be intercepted by the ditches or berms and will be conveyed to existing drainage systems or suitable discharge points. All the drainage ditches or berms were designed to handle the peak 25-year flow from the potential drainage area. By using low channel slopes, design flow velocities in the ditches will be maintained below established limits for sand channels.

Between the landfill crest and the perimeter road, the area will be graded to provide drainage toward the perimeter road. The perimeter road will be sloped outward, at a grade of approximately 2 percent, to provide drainage away from the landfill. On the outside of the perimeter road drainage ditches will be excavated to provide drainage away from the landfill.

4.3.8.1.1 Design and Performance [D-6h(1)(a)]

Design and performance details were determined for the landfill as part of the detailed design process.

4.3.8.1.2 Calculation of Peak Flow [D-6h(1)(b)]

Computation of design discharge for the drainage ditches or berms was performed using standard analytical methods, such as the Rational Method or the computer program HEC-1 (USACE 1981). The 25-year, 24-hour precipitation depth is 4.0 centimeters, based on precipitation data recorded from 1947 to 1969 (PNL-4622). The tributary area for each section of ditch or berm was based on local topography.

4.3.8.2 Run-Off Control System [D-6h(2)(a and b) and (3)]

There will be no run-off from the lined landfill because the landfill will be constructed below grade. Any precipitation falling on the landfill will be removed by either evapotranspiration or the leachate collection and removal systems. Therefore, a run-off control system will not be needed.

4.3.8.3 Construction [D-6h(4)]

The drainage ditches or berms around the lined landfill will be constructed with conventional earthmoving equipment such as graders and small dozers.

4.3.8.4 Maintenance [D-6h(5)]

The drainage ditches or berms will require periodic maintenance to ensure proper performance. The most frequent maintenance activity, beyond periodic inspection, will be cleaning the ditches or berms to remove obstructions caused by windblown soil and vegetation (e.g., tumbleweeds). After rare storm events, regrading of the ditch bottom or repair of the berm might be required to repair erosion damage. This is expected to occur infrequently; however, inspections will be conducted after 25-year storm events or at least annually.

4.3.9 Control of Wind Dispersal [D-6i]

The IDF will use varied methods to prevent wind dispersal of mixed waste and backfill materials, depending on the waste form. Methods to prevent wind dispersal include containerizing, stabilizing, grouting, spray fixitants, and backfill. In other instances, the operating contractor implements a wind speed restriction during handling, and immediately backfills the waste to prevent wind dispersal.

4.3.10 Liquids in Landfills [D-6j]

Free liquids will not be accepted except as allowed by Chapter 3.0, Section 1.2. Waste received at the IDF must comply with waste acceptance requirements.

4.3.11 Containerized Waste [D-6k]

Containerized waste received in the IDF lined landfill will be limited to a maximum of 10 percent void space. Several inert materials (diatomaceous earth, sand, lava rock) will be used as acceptable void space fillers for waste that does not fill the container.

This section has been identified as
"Official Use Only" (OUO)
and is available to view by appointment at
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

Figure 4.2. Example of a Typical Liner.

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PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 4A – Section 1 **Design Report – Critical Systems**

Integrated Disposal Facility (IDF) Phase I Critical Systems Design Report

Tables

Figures

Appendices

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
Affiliate	CH2M HILL, Inc.
AFI	Air freeze index
ALR	Action leakage rate
AOS	Apparent opening size
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
bgs	Below ground surface
CDN	Composite drainage net
CDR	Conceptual Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH2M HILL	CH2M HILL Hanford Group, Inc.
Design Report	IDF Phase I Critical Systems Design Report
DOE	U.S. Department of Energy
DBVS	Demonstration Bulk Vitrification System
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FH	Fluor Hanford, Inc.
FLA	Full load amperage
FS	Factor of safety
FVNR	Full Voltage Non-Reversing
GCL	Geosynthetic clay liner
GFCI	Ground fault circuit interrupters
gpm	Gallons per minute
GRI	Geosynthetic Research Institute
HDPE	High-density polyethylene
HEC	Hydraulic Engineering Circular-1
HELP	Hydrologic Evaluation of Landfill Performance (Model)
HF	Hanford Facility
HMS	Hanford Meteorological Station
HVAC	Heating, ventilating, and air conditioning
I/O	Input/output
ICDF	INEEL CERCLA Disposal Facility (Idaho Falls, ID)
IDF	Integrated Disposal Facility (Hanford)
IEEE	Institute of Electrical and Electronic Engineers
IES	Integrated Engineering Software, Inc.
ILAW	Immobilized low-activity waste
INEEL	Idaho National Environmental Engineering Laboratory
LAN	Local area network
LCRS	Leachate collection and removal system
LDS	Leak detection system
LERF	Liquid Effluent Retention Facility (Hanford)
LLW	Low-level waste
MBPS	Megabits per second
MCC	Motor control center
MLLW	Mixed low-level wastes
NEC	National Electrical Code
NFPA	National Fire Protection Association

OIU	Operator interface unit
ORP	Office of River Protection
PC	Performance category
PICS	Process Instrumentation and Control Systems
PLCs	Programmable logic controllers
PNNL	Pacific Northwest National Laboratory
psi	Pounds per square inch
PVC	Polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RAP	Response Action Plan
RCRA	Resource Conservation and Recovery Act of 1976
RF	Radio frequency
RGS	Rigid galvanized steel
RPP	River Protection Project
SCADA	Supervisory control and data acquisition
SDR	Standard dimension ratio
SOW	Statement of work
SPT	Standard Penetration Testing
SSCs	Systems, structures, and components
STI	Soil Technology, Inc. (Bainbridge Island, Washington)
THW	Thermoplastic, vinyl insulated building wire; flame retardant, moisture and heat resistant, 75°C, dry and wet locations
TSD	Treatment Storage and Disposal facility
TRU	Transuranic waste (concentrations of transuranic radionuclides greater than or equal to 100nCi/g of the waste matrix)
UBC	Uniform Building Code
UPS	Uninterrupted power supply
USCS	Unified Soil Classification System
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
WTP	Waste Treatment and Immobilization Plant (Hanford)

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of the Integrated Disposal Facility (IDF) is to develop the capability for near-surface disposal of Immobilized Low-Activity Waste (ILAW) waste packages from the River Protection Project-Waste Treatment Plant (RPP-WTP). The IDF is essential in meeting the overall U.S.Department of Energy-Office of River Protection (DOE-ORP) mission to store, retrieve, treat, and dispose of the highly radioactive Hanford tank waste in an environmentally sound, safe, and cost-effective manner. The IDF will also provide capacity for disposal of waste from the DBVS. The detailed design for the IDF Critical Systems will finalize the design process for the:

- Landfill liner system
- Leachate removal system
- Leak detection system (LDS)

The Integrated Disposal Facility (IDF) detailed design also involves completing all design work required for an operable landfill and supporting the Resource Conservation and Recovery Act of 1976 (RCRA) Part B permitting for the IDF.

This Phase I Critical Systems Design Report (the Design Report) provides documentation of engineering calculations, criteria, and information that have been developed as part of the IDF detailed design for Phase I. Specifically, the Design Report documents the following important design information:

- Identifies key design requirements for the project (Section 2)
- Summarizes studies on site conditions and investigations that have been used in the development of detailed design parameters for the critical systems (Sections 3 and 4)
- Presents detailed engineering analysis performed in the development of the Phase I Critical Systems design (Section 5)
- Provides system component descriptions, references important construction quality assurance (QA) requirements, and describes important interfaces with non-critical systems (Section 6)
- Describes operating provisions that have influenced the development of the design including waste placement requirements, operational interfaces with other Hanford facilities, and leakage response action plan requirements (Section 7)

1.2 SCOPE

1.2.1 General

CH2M HILL, Inc. (Affiliate) is responsible for production of a cost-effective final design and to produce critical systems detailed design documents and construction specifications to facilitate RCRA permit approval of the IDF. The IDF technical requirements are found in the following documents:

- Immobilized Low-Activity Waste (ILAW) Project Definition Criteria, Revision 1 (RPP-7898).
- System Specifications for ILAW Disposal, Revision 3 (RPP-7307).
- Hanford Environmental Management Specification (DOE/RL-97-55).

Design products are to be prepared in compliance with the technical requirements, as well as with other specific procedures that are dictated by CH2M HILL Hanford Group, Inc. (CH2M HILL) requirements and outlined in the Statement of Work (SOW), *Integrated Disposal Facility Detailed Design Support* (Rev. 2, 2003), described in more detail under Section 2 of this Design Report. The overall design work includes reports, schedules, estimates, and other special services as specified in the SOW. As part of the design effort, the Affiliate will perform the following global tasks:

- Develop a conceptual layout and preliminary design drawings for the IDF. The IDF preliminary layout will depict a single expandable landfill system, with capability for segregation of RCRA regulated and non-regulated waste placement and segregated leachate management systems.
- Develop a detailed design that meets the requirements of the ILAW Project Definition Criteria and the ILAW System Specification.
- Develop the construction specifications for the detailed design.
- Ensure that there is full technical integration between all detailed design reports prepared for the detailed design of the IDF.
- Perform the design activities in accordance with all applicable regulatory requirements.

The design will implement the safety and health protection requirements imposed on the design by the SOW and the technical baseline criteria documents, and will comply with all applicable regulatory requirements for the project. It is important to note that although the design is for identified critical systems of the Phase I IDF, a preliminary safety evaluation was performed for the W-520 Project that identified no safety class items, including criticality safety (*Conceptual Design Report for ILAW Facility*, CH2M HILL, May 2001).

The timely completion of the critical system detail design of the IDF, in compliance with the RCRA permit approval process (Washington Administrative Code [WAC] 173-303-665 and 173-303-806[4][h]), is a critical component of the SOW. Drawings, construction specifications, and reports needed to obtain U.S. Department of Energy (DOE) certification and Washington State Department of Ecology (Ecology) approval of the IDF RCRA Part B permit is the overall goal of the project. The detailed design for the initial Phase I disposal landfill and the critical systems design include the liner system, the leachate collection system, and the LDS. The detailed design will produce an operable landfill design and support the IDF RCRA Part B permitting.

1.2.2 Design Report

The Design Report describes the key facility components and provides the design basis and detailed calculations that support the development of drawings and specifications. Key facility components that are described in the Design Report include:

- Facility layout (location, access roads and operational ramps, survey control system).
- Landfill geometry (disposal volume total and per disposal unit, disposal unit dimensions).
- Disposal unit grading design (foundation soils contour, lower admixture layer contour, operations layer cover contour).
- Grid point listing (grid point number, location, and elevation for all grid points required for construction of the IDF).
- Geosynthetic material design (primary geomembrane, secondary geomembrane, geotextile, and geocomposite drainage layer).
- Leachate collection and removal system (LCRS) and LDS design (sump design, removal system design–LCRS and LDS, leachate level monitoring system design, transfer pump as required to

meet WAC-173-303-665 (2)(h)(ii) to ensure that the leachate depth over the liner does not exceed 12 inches).

- Leachate temporary storage tank system design (tank volume, tank design, tank materials/ leachate compatibility, tank coating, tank secondary containment system), including electrical and power requirements necessary to support the leachate removal systems.

- Pump controls and instrumentation design (control, operations, monitoring, and control building design).

- Operational storm water management design.

- Backfill placement requirements and process (minimize void space, minimize subsidence of waste, placement and material requirements to ensure there are no adverse effects on the waste packages).

- Other facility designs identified as necessary to support the project completion.

The Design Report includes design calculations that are prepared in accordance with the requirements of procedure HNF-IP-0842 Vol. 4, Section 3.6 (July 30, 2002). Important calculations that are documented include:

- Stability (liner side slope [each liner layer based on interface strength], requirements for verification for critical interface strengths, fill placement ramp, global stability of the overall design, and other relevant stability analysis).

- Seismic analysis (side slope and global embankment stability under seismic loading, and seismic design of structures).

- Bearing capacity (liner sub-grade soils and other relevant bearing capacity analysis).

- Total settlement, differential settlement, and uplift analysis (foundations soils, compacted admixture layers, total settlement, top slope drainage evaluation, subsidence and sinkhole potential, uplift potential, and other relevant settlement analysis).

- Admix liner analysis (liner admixture bearing capacity, admix liner specifications, desiccation cracking, and other relevant liner admixture analysis).

- Geomembrane liner analysis (liner tension caused by thermal contraction/ expansion, anchor trench pullout analysis, puncture resistance, potential stress cracking, leachate compatibility, chemical and radiation resistance, mechanical degradation from operational traffic, and other relevant geomembrane analysis).

- Drainage layers analysis (geotextile analysis and selection, geocomposite selection, drainage gravel selection analysis, and other relevant drainage analysis).

- LCRS/LDS analysis (clogging prevention in LCRS, design of leachate collection sumps, design of high capacity and low capacity leachate removal pumping systems, design of leachate storage tank and secondary containment system, leachate depth monitoring system, design of leachate system control building, leachate compatibility of components in the LCRS, and other relevant leachate analysis).

- Leachate system earth loading analysis (LCRS and LDS slope riser pipes, LCRS collection pipe, leachate transfer pipes, and other relevant system loading analysis).

- Surface stormwater analysis (operations in-cell stormwater management, operations runon/runoff water management, site stormwater collection/evaporation management system, and other relevant storm water analysis).

- Leachate production analysis (average annual leachate production, peak daily leachate production, leachate tank storage capacity, leachate transportation truck capacity, and trip frequency).

- Action leakage rate (ALR) analysis (the maximum design flow rate that the secondary leachate collection, detection, and removal system can remove without the fluid head on the bottom liner exceeding one foot; calculation and justification of the maximum leachate infiltration rate through the primary liner system; a response action plan in case the maximum ALR is exceeded during operation of the IDF).

Compliance matrices have been developed to demonstrate detailed design compliance with the applicable sections of the regulations (WAC 173-303) and with project-specific specifications, criteria, reports, codes, and standards. These matrices are presented in the Design Report in Appendix A.

1.3 AUTHORIZATION

After careful consideration and evaluation, CH2M HILL elected to self-perform the IDF Phase I Critical Systems design. As such, the design is being performed as an inter-company work assignment by the Affiliate under the direction of CH2M HILL. CH2M HILL was authorized to self-perform the work by the U.S. Department of Energy, Office of River Protection (ORP), in a letter dated December 9, 2002.

CH2M HILL's Prime Contract Number with the ORP is DE-AC06-99RL14047. The inter-company work assignment is Contract 12317, Release 22, dated November 7, 2002.

1.4 GENERAL FACILITY DESCRIPTION

The IDF will consist of an expandable lined landfill located in the 200 East area on the Hanford Facility (HF). The landfill will be divided lengthwise into two distinct cells, one for disposal of low-level waste (LLW) and the other for disposal of mixed waste. The mission of the IDF will include the following functions:

- Provide an approved disposal facility for the permanent, environmentally safe disposition of ILAW packages that meets the environmental requirements and is approved by the DOE and Ecology.

- Receive ILAW from River Protection Project (RPP) tank operations and dispose this waste onsite. Receive waste from the DBVS and dispose this waste onsite.

A more detailed discussion of waste types and the necessary storage volumes for these wastes is provided in Sections 5 and 6, respectively.

The IDF will be constructed on 25 hectares of vacant land southwest of the PUREX Plant in the 200 East Area . The IDF will consist of a lined landfill that will be constructed in several phases. The landfill will be segregated into a RCRA permitted cell and a non-RCRA permitted cell. The scope of this permit is limited to the western cell of the landfill where the RCRA waste will be stored and disposed. The landfill is designed to accommodate four layers of vitrified LAW waste containers separated vertically by 0.9-meters of soil.

This initial construction will start at the northern edge and the size is approximately 223 meters East/West by 233 meters North/South by 14 meters deep. At this initial size, IDF disposal capacity is 82,000 cubic meters of waste. Subsequent construction phase(s) will require a modification to the Part B Permit to be constructed after waste placement has progressed in the landfill to the point that additional disposal capacity is needed. This approach minimizes the open area susceptible to collection of rainwater and subsequent leachate

The landfill, is currently estimated at full build out to be up to 446 meters wide by 555 meters in length by up to 14 meters deep. The RCRA regulated portion of the landfill would be half of that at approximately 223 meters wide by 555 meters long by up to 14 meters deep providing a waste disposal capacity of up to 450,000 cubic meters.

Both cells will have a RCRA C-compliant liner system that consists of an upper primary liner overlying a lower secondary liner. The upper liner will consist of a composite geomembrane liner and geosynthetic clay liner system on the bottom area, and a single geomembrane on the side slope. The secondary liner will consist of a composite geomembrane, overlying a 3-foot-thick soil admix liner. A LCRS and a LDS will overly the primary and secondary liner system, respectively. A Secondary Leak Detection System (SLDS) will be located below the clay liner, beneath the LDS sump.

The IDF also will include a less than 90-day accumulation area of leachate for storage in two tanks, one per landfill half. The leachate storage tanks will be located at the north end, in close proximity to the lined landfill. Each tank will be protected by secondary containment (double-lined tanks). Leak detection will be provided by monitoring of the secondary containment. The collected leachate will be stored and sampled before transfer to an onsite Treatment Storage and Disposal (TSD) unit or offsite TSD facility. The less than 90-day storage leachate collection tank will be operated in accordance with the generator provisions of WAC 173-303-200 and WAC 173-303-640, as referenced by WAC 173-303-200. The overall side development plan is shown in Figure 1-2.

The landfill will be constructed in several phases. Starting at the northern edge, approximately one-third of the total length of the landfill will be constructed in Phase I. This will include the leachate collection system and 90-day accumulation tanks. The subsequent phases will be constructed after waste has been placed in the landfill and additional disposal capacity is needed. This approach will minimize the amount of open area susceptible to collection of rainwater and subsequent leachate.

Before disposal, all waste will meet land disposal restriction requirements [Revised Code of Washington 70.105.050(2), WAC 173-303-140, and 40 Code of Federal Regulations (CFR) 268, incorporated by reference in WAC 173-303-140].

Future landfill development and configuration within the IDF will be subject to change as disposal techniques improve or as waste management needs dictate. Additional IDF landfill development beyond the 62 acres will be subject to an approved permit modification, in accordance with the HF RCRA Permit (Ecology, 2001).

Public access to the IDF will be restricted. Figure 1-3 depicts the normal transportation routes within the 200 East area. Trucks typically will be used to transport waste to the IDF and will range in size from heavy duty pickups to tractor-trailer rigs, depending on the size and weight of the load. In some cases, special equipment (such as transporters) will be used for unusual or unique loads. When special equipment is used, a prior evaluation will ensure that the equipment does not damage the roadways.

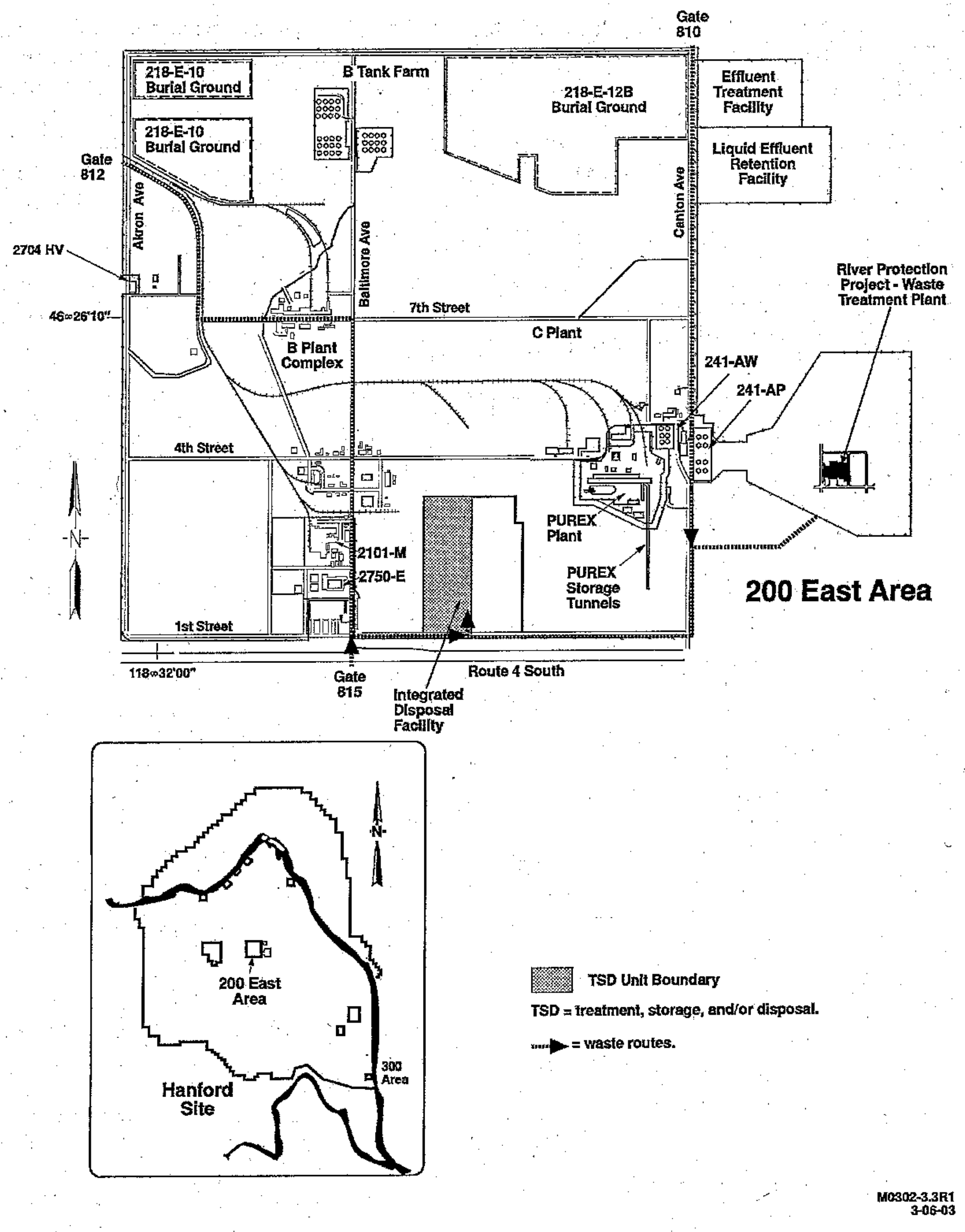
Approximately 60 personnel will traverse this roadway, in personal vehicles in three shifts per 24 hours per week.

Figure 1-1: Integrated Disposal Facility Site Plan

This section has been identified as
"Official Use Only" (OUO)
and is available to view by appointment at
the Nuclear Waste Program
Resource Center
3100 Port of Benton
Richland, Washington.

Please contact Valarie Peery at
(509) 372-7920
for a viewing appointment.

Figure 1-3: Transportation Routes to the Integrated Disposal Facility



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2.0 DESIGN REQUIREMENTS

Minimum design requirements for the IDF Phase I Critical Systems Design were provided by CH2M HILL in the SOW for Requisition # 92859, Integrated Disposal Facility Detailed Design Support, Revision 2, February 18, 2003. The IDF Phase I Critical Systems Design has been performed in compliance with all applicable design requirements, defined in Sections 2.1 through 2.7, and these requirements are:

- *Washington State Dangerous Waste Regulations* (WAC 173-303)
- *System Specification for Immobilized Low-Activity Waste Disposal System,* Revision 3 (RPP-7307)
- *ILAW Project Definition Criteria for Integrated Disposal Facility,* Revision 1 (RPP-7898)
- *Hanford Site Environmental Management Specification,* Revision 2 (DOE/RL-97-55)
- *Design Loads for Tank Farm Facilities* (TFC-ENG-STD-06, REV A)
- Technical baseline documents listed in Section 3.1 of the SOW
- Applicable national codes and standards

2.1 WASHINGTON STATE DANGEROUS WASTE REGULATIONS

The *Washington State Dangerous Waste Regulations* (WAC 173-303) implement Subtitle C of Public Law 94-580, the RCRA in the State of Washington. By conforming to the requirements of WAC 173-303, the design of the IDF Phase I Critical Systems also complies with the federal hazardous waste requirements contained in 40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*. Appendix A.1 provides a compliance matrix of where the applicable WAC 173-330 requirements are addressed in the IDF Phase I Critical Systems detailed design documents.

2.2 SYSTEM SPECIFICATION

The *System Specification for Immobilized Low-Activity Waste Disposal System*, Revision 3 (RPP-7307) contains the Level 1 system requirements for the Immobilized Low-Activity Waste Disposal System, of which the IDF is a part. Appendix A.2 provides a compliance matrix of where the applicable Level 1 system requirements are addressed in the IDF Phase I Critical Systems detailed design documents.

2.3 PROJECT DEFINITION CRITERIA

The *ILAW Project Definition Criteria for Integrated Disposal Facility*, Revision 1 (RPP-7898) contains the design criteria for the IDF, including requirements flow-down from RPP-7303, *System Specification for ILAW Disposal System*, and DOE/RL-97-55, *Hanford Site Environmental Management Specification*. Appendix A.3 provides a compliance matrix of where the applicable design criteria are addressed in the IDF Phase I Critical Systems detailed design documents.

2.4 HANFORD SITE ENVIRONMENTAL MANAGEMENT SPECIFICATION

The *Hanford Site Environmental Management Specification* (site specification), Revision 2 (DOE/RL-97-55) documents the top-level mission technical requirements for work involved in the Richland Operations Office, Hanford Site cleanup and infrastructure activities, under the responsibility of the DOE Office of Environmental Management. It also provides the basis for all contract technical requirements. Section

3.3.2, 200 Area Materials and Waste Management of the site specification contains the requirements for receiving and onsite disposal of ILAW from RPP tank operations. The documents, orders, and laws referenced in the site specification represent only the most salient sources of requirements. As such, the site specification is assumed to have no significant measurable requirements that would directly affect the IDF Phase I Critical Systems design.

2.5 DESIGN LOADS FOR TANK FARM FACILITIES

The *Design Loads for Tank Farm Facilities* (TFC-ENG-STD-06, REV A) defines the design requirements for systems, structures, and components (SSCs), and provides the minimum criteria for structural design and evaluation of SSCs. The standard establishes structural design loads and acceptance criteria for use in designing new SSCs. Figure 1 of this standard indicates that for new SSCs, structures and anchorage of systems and components are to be designed per DOE-STD-1020-02 and Section 3.0 of this standard. These were used for the design of the IDF Critical Systems facilities. The IDF Critical Systems facilities were defined by CH2M HILL as being Performance Category (PC)-1. The PC-1 requirements in this standard were used in the structural design of the facilities included in IDF Phase I Critical Systems.

2.6 TECHNICAL BASELINE DOCUMENTS

The technical baseline documents are listed in Section 3.1 of the SOW. These documents include the System Specification for Immobilized Low-Activity Waste Disposal System, ILAW Project Definition Criteria for Integrated Disposal Facility, Hanford Site Environmental Management Specification, and Design Loads for Tank Farm Facilities, discussed in the preceding sections.

2.7 NATIONAL CODES AND STANDARDS

In addition to WAC 173-303, the system specification, project definition criteria, site specification, and tank farm design loads that are discussed above, the IDF Phase I Critical Systems design was guided by other applicable sections of accepted professional and industry standards. These included the following:

- Air Moving and Conditioning Association
- American Association of State Highway and Transportation Officials (AASHTO)
- American Concrete Institute
- American Galvanizers Association
- American Institute of Steel Construction
- American Iron and Steel Institute
- American National Standards Institute
- American Society for Testing and Materials (ASTM)
- American Society of Civil Engineers (ASCE)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- American Society of Mechanical Engineers
- American Water Works Association (AWWA)

- American Welding Society
- Building Officials and Code Administrators – Basic Building Code
- Code of Federal Regulations (CFR)
- Concrete Reinforcing Steel Institute (CRSI)
- Federal Standards
- Geosynthetic Research Institute (GRI)
- Hydraulic Institute Standards
- Institute of Electrical and Electronic Engineers (IEEE)
- International Conference of Building Officials – Uniform Building Code (UBC)
- Manufacturers Standardization Society
- Metal Building Manufacturers Association
- National Electrical Code (NEC)
- National Electrical Manufacturers Association
- National Fire Protection Association (NFPA)
- National Institute of Standards and Technology
- Occupational Safety and Health Administration
- Sheet Metal and Air Conditioning Contractors National Association
- Steel Door Institute
- Steel Structures Painting Council
- Specialty Steel Institute of North America
- The Aluminum Association, Inc.
- Underwriters Laboratories, Inc.
- Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge and Municipal Construction.

3.0 SITE CONDITIONS

This section presents information on the Hanford Site and the area on the site where the IDF will be located. This information was obtained primarily from the *ILAW Preliminary Closure Plan for the Disposal Facility* (RPP-6911) and other Hanford Site data sources. It is intended to provide a general characterization of the IDF site conditions that are pertinent to the design of the IDF Phase I Critical Systems.

3.1 GEOGRAPHY

The following paragraphs briefly describe the geography of the IDF site and are prepared from information in the *ILAW Preliminary Closure Plan for the Disposal Facility* (RPP-6911).

3.1.1 Site Location

The location of the IDF is on the Hanford Central Plateau, in the 200 East area within the Hanford Site boundary. The site identified for the IDF is 68 hectares (168 acres) of vacant and uncontaminated land, located southwest of the PUREX plant in the 200 East area. It is bounded on the south by 1st Street and on the north by 4th Street.

3.1.2 Site Description

The IDF landfill will occupy approximately 25 hectares (62 acres) of the site identified for the facility. The remainder of the site will be used for soil stockpile, leachate storage tanks, operations support facilities, roads, parking areas, and open space. The IDF in Phase I will be approximately 11 hectares (28 acres). Phase I will be located at the north end of the IDF landfill and will include provisions for expansion to the south for future phases.

3.2 METEOROLOGY AND CLIMATOLOGY

The following paragraphs briefly describe the climate of the IDF site and are prepared from information in the *ILAW Preliminary Closure Plan for the Disposal Facility* (RPP-6911), which presented summary data from the Hanford Meteorological Station (HMS). Conditions at the HMS are considered similar to those at the IDF site. Detailed information is available in the *Hanford Site Climatological Data Summary 2001, with Historical Data* (Pacific Northwest National Laboratory, May 2002). The IDF Phase I Critical Systems is designed to operate in the climatic conditions reported in that document.

3.2.1 Precipitation

The site sits within the Pasco Basin, characterized as a semi-arid region because of its low annual precipitation levels. The basin receives 16 cm (6.3 inches) of annual average precipitation, with nearly half occurring in the winter months. Historical records indicate that the annual precipitation has varied from a low of 8 cm (3.1 inches) to a high of 30 cm (11.8 inches). Precipitation of 4 cm (1.56 inches) in 24 hours reportedly can be expected to occur once every 25 years. However, based on the *Hanford Site Climatological Data Summary 2001*, a value of 1.28 inches was used for the 24-hour, 25-year precipitation in the IDF Phase I Critical Systems stormwater design analysis (see Appendix C.9). Total annual snowfall has varied from 0.8 cm to 110 cm (0.31 to 43.3 inches), with an average annual snowfall of 34 cm (24.4 inches).

3.2.2 Temperature

Temperature conditions for the site range from extremely cold during the winter months to extremely warm during the summer months. Local temperatures can reach -18 degrees C (0 degrees F) during some winter months. January is the coldest month, with an average temperature of -2 degrees C (29 degrees F).

The lowest temperature ever recorded was -33 degrees C (-27 degrees F). During some summer months, daytime temperatures can exceed 40 degrees C (104 degrees F). July is the warmest month, with daily high and low temperatures averaging 33 and 25 degrees C (92 and 61 degrees F), respectively. The highest temperature ever recorded was 46 degrees C (115 degrees F).

3.2.3 Wind

Wind conditions can vary considerably throughout the year. The monthly average is about 10 kilometers/hour (6 miles/hour) during the winter and 15 kilometers/hour (9 miles/hour) during the summer. Wind speeds, especially during summer storm activity, can reach many times the average levels. The greatest peak gust was 130 kilometers/hour (81 miles/hour), recorded at 15 meters (50 feet) above the ground at the HMS.

3.2.4 Relative Humidity

The seasonal variation in the relative humidity is considerable, according to records of the HMS. The annual mean relative humidity recorded at HMS is approximately 54 percent, with the highest monthly average relative humidity (80 percent) occurring in December and the lowest monthly average relative humidity (32 percent) occurring in July. Daily relative humidity can change 20 to 30 percent between early morning and late afternoon, except in the winter months when changes are less pronounced.

3.3 ECOLOGY

The following paragraphs briefly describe the ecology of the Hanford Site and are prepared from information in the *ILAW Preliminary Closure Plan for the Disposal Facility* (RPP-6911). The site consists of undeveloped land and is characterized as a shrub-steppe environment. This environment contains numerous plants and animal species, adapted to the regions semi-arid climate. Because of the aridity and low water-holding capacity of the soils, the productivity of both plants and animals is relatively low. The IDF site exhibits many of these same general characteristics, although to varying degrees.

3.3.1 Flora

The dominant plants on the Hanford Site are big sagebrush, rabbitbrush, cheatgrass, Russian thistle, and Sandberg's bluegrass, with cheatgrass providing half of the plant cover. Root penetration to depths of over 3 m has not been demonstrated in the 200 Areas. Rabbitbrush roots have been found only at a depth of 2.4 m (8 feet) near the 200 Areas.

3.3.2 Fauna

A variety of birds and mammals inhabit the Hanford Site. The most abundant nesting birds of the shrub-steppe at the site are the horned lark and western meadowlark. Significant populations of chukar and grey partridge inhabit the Hanford Site. The most abundant mammals at the site are mice, ground squirrels, gophers, voles, and cottontail rabbits. Larger animals include mule deer and elk. The coyote is the principal mammalian predator on the Hanford Site.

3.4 GEOLOGY

3.4.1 Regional Geology

The 200 East Area lies on the Cold Creek bar, a geomorphic remnant of the cataclysmic, glacial related floods of the Pleistocene Epoch. As the floodwaters raced across the lowlands of the Pasco Basin and Hanford Site, floodwaters lost energy and began to deposit sand and gravel. The 200 Area Plateau is one of the most prominent deposits. The 200 Area Plateau lies just southwest of one of the major flood channels across the Hanford Site that forms the topographic lowland south of Gable Mountain.

Borehole data provide the principal source of geologic, hydrologic, and groundwater information for the 200 East area and the IDF site. Numerous boreholes (both vadose zone boreholes and groundwater monitoring wells) have been drilled in the 200 East area for groundwater monitoring and waste management studies (Figure 3-1 shows the location of groundwater wells near the IDF site). However, data are limited within the IDF site, primarily because no previous construction or waste disposal activities have occurred in this part of the HF. Most boreholes in the 200 East area have been drilled using the cable tool method and either a hard tool or drive barrel to advance the hole. Some boreholes have been drilled by rotary and wire-line coring methods. More recently, boreholes in the area have been drilled, and in five cases cored, by percussion hammer methods. Geologic logs are based on examination of drill core, chips, and cuttings from these boreholes. Chip samples typically are taken at 1.5-meter (4.92 feet) intervals and routinely archived at the Hanford Geotechnical Sample Library.

3.4.2 Site Geology

The IDF site will be located south of the Gable Mountain segment of the Umtanum Ridge anticline and about 3 kilometers (1.86 miles) north of the axis of the Cold Creek syncline, that controls the structural grain of the basalt bedrock and the Ringold Formation. The basalt surface and Ringold Formation trend roughly southeast-northwest parallel to the major geologic structures of the site. As a result, the Ringold Formation and the underlying Columbia River Basalt Group gently dip to the south off the Umtanum Ridge anticline into the Cold Creek syncline.

Geologic mapping on the Hanford Site and examination of drill core and borehole cuttings in the area have not identified any faults in the vicinity of the IDF site (DOE/RW-0164). The closest known faults are along the Umtanum Ridge-Gable Mountain structure, north of the disposal site and the May Junction Fault east of the site (Figure 3-2).

3.4.2.1 Stratigraphy

The basalt and post-basalt stratigraphy for the IDF site is shown in Figure 3-3. Approximately 137 to 167 meters (449 to 548 feet) of suprabasalt sediments overlie the basalt bedrock at the site.

Basalt Bedrock. Previous studies (RHO-BWI-ST-14; Reidel and Fecht, 1994) have shown that the youngest lava flows of the Columbia River Basalt Group at the 200 East Area are those of the 10.5 million-year old Elephant Mountain Member. This member underlies the entire 200 East area and surrounding area, and forms the base of the suprabasalt aquifer. No erosional windows in the basalt are known or suspected to occur in the area of the IDF site.

Ringold Formation. Few boreholes penetrate the entire Ringold Formation at the IDF site, so available data are limited. The Ringold Formation reaches a maximum thickness of 95 meters (312 feet) on the west side of the site and thins eastward. The member of Wooded Island (Figure 3-3) is the only member of the Ringold Formation in the 200 East area. The deepest Ringold Formation unit encountered is the lower gravel, unit A. Lying above unit A is the lower mud, and overlying the lower mud is an upper gravel, unit E. The sand and silt units of the members of Taylor Flat and Savage Island of the Ringold Formation are not present at the IDF site. Unit A and unit E are equivalent to the Pliocene-Miocene continental conglomerates (Reidel and Fecht, 1994). The lower mud is equivalent to the Pliocene-Miocene continental sand, silt, and clay beds (Reidel and Fecht, 1994).

Only three boreholes have penetrated unit A in the area of the IDF site. Unit A is 19 meters (62 feet) thick on the west side of the site and thins to the northeast. Unit A is partly to well-cemented conglomerate consisting of both felsic and basaltic clasts in a sandy matrix and is interpreted as fluvial gravel facies (Lindsey, 1996). There are minor beds of yellow to white interbedded sand and silt.

Green-colored, reduced-iron stain is present on some grains and pebbles. Although the entire unit appears to be cemented, the zone produced abundant high-quality water in borehole 299-E17-21 (PNNL-11957, 1998).

Nineteen meters (62 feet) of the lower mud unit were encountered in one borehole at the IDF site (PNNL-11957, 1998). The uppermost one meter or so consists of a yellow mud to sandy mud. The yellow mud grades downward into about 10 meters (33 feet) of blue mud. The blue mud, in turn, grades down into seven meters (23 feet) of brown mud with organic rich zones and occasional wood fragments. The lower mud unit is absent in the center of the site (northeast of borehole 299-E24-7 on Figure 3-4).

Unit E is described as a sandy gravel to gravelly sand. Unit E is interpreted to consist of as much as 15 meters (49 feet) of conglomerate, with scattered large pebbles and cobbles up to 25 centimeters (9.84 inches) in size in a sandy matrix. The gravel consists of both felsic and basaltic rocks that are well rounded, with a sand matrix supporting the cobbles and pebbles. Cementation of this unit ranges from slight to moderate. The upper contact of unit E is not identified easily at the IDF site. In the western part of the study area, unconsolidated gravels of the Hanford formation directly overly the Ringold Formation unit E gravels, making exact placement of the contact difficult. The dominance of basalt and the absence of cementation in the Hanford formation are the key criteria used to distinguishing these here (PNNL-11957, 1998). In the central and northeast part of the area, unit E has been eroded completely. Unconsolidated gravels and sands typical of the Hanford formation replace unit E.

Unconformity at the Top of the Ringold Formation. The surface of the Ringold Formation is irregular in the area of the IDF site. A northwest-southeast trending erosional channel or trough is centered through the northeast portion of the site. The trough is deepest near borehole 299-E24-21 in the northern part of the site (PNNL-13652, 2001). This trough is interpreted as part of a larger trough under the 200 East area, resulting from scouring by the Missoula floods.

Hanford formation. The Hanford formation is as much as 116 meters (381 feet) thick in and around the IDF site. The Hanford formation thickens in the erosional channel cut into the Ringold Formation and thins to the southwest along the margin of the channel.

At the IDF site, the Hanford formation consists mainly of sand dominated facies and less amounts of silt dominated and gravel dominated facies. The Hanford formation has been described as poorly sorted pebble to boulder gravel and fine- to coarse-grained sand, with lesser amounts of interstitial and interbedded silt and clay. In previous studies of the site (WHC-MR-0391, 1991), the Hanford formation was described as consisting of three units: an upper and lower gravel facies and a sand facies between the two gravelly units. The upper gravel dominated facies appears to be thin or absent in the immediate area of the IDF site (PNNL-12257, 1999; PNNL-13652, 2001; PNNL-14029, 2002).

The lowermost part of the Hanford formation encountered in boreholes at the IDF site consists of the gravel dominated facies. Drill core and cuttings from boreholes 299-E17-21, 299-E17-22, 299-E17-23, 299-E17-25, and 299-E24-21 indicate that the unit is a clast-supported pebble- to cobble-gravel with minor amounts of sand in the matrix. The cobbles and pebbles almost are exclusively basalt, with no cementation. This unit pinches out west of the IDF site and thickens to the east and northeast (Figure 3-4). The water table beneath the IDF site is located in the lower gravel unit. The lower gravel unit is interpreted to be Missoula flood gravels, deposited in the erosional channel carved into the underlying Ringold Formation.

The upper portion of the Hanford formation consists of at least 73 meters (240 feet) of fine-to coarse-grained sand, with minor amounts of silt and clay and some gravelly sands.

Holocene Deposits. Holocene, eolian deposits cover the southern part of the IDF site. Caliche coatings on the bottom of pebbles and cobbles in drill cores through this unit are typical of Holocene caliche development in the Columbia Basin. The southern part of the IDF site is capped by a stabilized sand dune. The eolian unit is composed of fine- to coarse-grained sands with abundant silt, as layers and as material mixed with the sand.

Clastic Dikes. A clastic dike was encountered in borehole C3828, adjacent to well 299-E17-25 at the IDF site. Clastic dikes also have been observed in excavations surrounding the site (e.g., U.S. Ecology, the former Grout area, the 216-BC cribs, the Central Landfill, and the Environmental Restoration Disposal Facility [PNNL, BHI-01103]). In undisturbed areas such as the IDF site, clastic dikes typically are not observed because these are covered by wind blown sediments. The occurrence of a clastic dike in borehole C3828 suggests that these probably are present elsewhere in the subsurface at the disposal site.

3.4.3 Seismology

The IDF will be located in Zone 2B, as identified in the UBC (DOE/RL-91-28). The analyses in Sections 5.1 and 5.12 provide additional seismic detail for design of liner and structural systems.

No active faults, or evidence of a fault that has had a displacement during Holocene times, have been found on the Hanford Site (DOE/RL-91-28). The youngest faults recognized on the Hanford Site occur on Gable Mountain, over 4.5 kilometers (2.78 miles) north of the 200 East area. These faults are Quaternary of age and are considered 'capable' by the Nuclear Regulatory Commission (DOE/RL-91-28).

3.5 HYDROLOGY

The following paragraphs briefly describe the known hydrology conditions of the Hanford Site and most specifically the 200 Area Plateau where the IDF site is located. These are prepared from information in the *ILAW Preliminary Closure Plan for the Disposal Facility* (RPP-6911).

3.5.1 Surface Water

The IDF site is within the 200 East area, which is on a plateau above the Columbia River. The Columbia River runs generally to the east and swings around the site, lying about 8 miles northwest and northeast of the 200 East area. The project area is significantly higher than the Columbia River and is not in the river's floodplain.

The soils in the project area are sandy with high rates of infiltration. Most of the precipitation falling on the site infiltrates into the ground, and there are no significant long-term surface water features in the project area.

3.5.2 Groundwater

The geologic structure of the 200 East area is composed of multiple layers of sediments that range from sand, silt, volcanic ash, and clay to coarse gravels, cobbles, and conglomerates that overlay thick layers of basaltic lava. An unconfined aquifer exists in the lower part of the sedimentary sequence, overlaying the uppermost basalt layer. This relatively thin aquifer intercepts infiltration from the unsaturated zone above it. The aquifer under the IDF site is approximately 90 to 100 meters (300 to 330 feet) below the ground surface. Therefore, the groundwater table is well below the proposed bottom of the excavation for the IDF and is not expected to influence the facility. The recharge of water into the ground at the IDF site is expected to be small. This condition results primarily from the low levels of annual precipitation that occur in the region of the IDF as well as the rest of the Hanford Site. A more detailed description of groundwater beneath the IDF, developed from various site explorations performed in the site area, is presented below.

The unconfined aquifer under the IDF site occurs in the fluvial gravels of the Ringold Formation and flood deposits of the Hanford formation. The thickness of the aquifer ranges from about 70 meters (230 feet) at the southwest corner of the site to about 30 meters (98 feet) under the northeast corner of the IDF site. The Elephant Mountain Member of the Columbia River Basalt Group forms the base of the unconfined aquifer (Figure 3-3).

The unsaturated zone beneath the land surface at the IDF site is approximately 100 meters (328 feet) thick and consists of the Hanford formation. The water level in boreholes in and around the site indicates that the water table is in the lower gravel sequence of the Hanford formation and at an elevation of approximately 123 meters (404 feet) above sea level. The water table is nearly flat beneath the IDF site. Table 3-1 gives water level information from wells near the site. The locations of the wells are shown on Figure 3-1. The latest water table map shows less than about 0.1 meter (3.94 inches) of hydraulic head across the IDF site (PNNL-13404, 2001).

The Ringold Formation lower mud unit occurs within the aquifer at the southwest corner of the IDF site (299-E17-21) but is absent in the central and northern parts of the site (299-E24-7 and 299-E24-21). The lower mud unit is known to be a confining or partly confining layer at places under the Hanford Site (PNNL-12261, 2000), and this might be the case under the southwest corner of the IDF site. Groundwater samples were collected and analyzed from above and below the lower mud unit during drilling of well 299-E17-21. Chemical parameters (pH, electrical conductivity, and Eh) were different in the two samples, suggesting that the lower mud is at least partly confining in the area. No contamination was found above or below the lower mud. An interpretation of the distribution and thickness of this stratum is shown in Figure 3-4. The surface of the lower mud unit is interpreted to dip gently to the southwest (PNNL-13652, 2001).

Hydrographs for selected wells near the IDF site are shown in Figures 3-5 and 3-6. Hydrographs for the older wells (299-E23-1, 299-E23-2, and 299-E24-7) show two maxima in the water level. These coincide with the operation of the PUREX Plant that operated between 1956 and 1972 and between 1983 and 1988. All the hydrographs show a decline in the water table during recent years. The rate of decline is between 0.18 and 0.22 meters (7.08 and 8.66 inches)/year and will take between 10 and 30 years to stabilize. The reason for the decline is the cessation of effluent discharge to the PUREX Plant and to the 216-B Pond System, centered northeast of 200 East area. Based on hindcast water table maps (PNNL, BNWL-B-360), the water table is expected to decline another 2 to 7 meters (7 to 23 feet) before reaching pre-Hanford Site elevations. The cessations of effluent discharge also are responsible for changing the direction of groundwater flow across much of the 200 East area.

Groundwater flow beneath the IDF site recently was modeled to be southeasterly (PNNL-13400, 2000). This direction differs from the easterly direction, predicted by the analysis of WHC-SD-WM-RPT-241 and other earlier reports. The southeasterly flow direction primarily is attributable to inclusion of the highly permeable Hanford formation sediments in the ancestral Columbia River/Missoula flood channel in the analysis. A southeasterly flow direction is reflected in the geographic distribution of the regional nitrate and tritium plumes in the south-central 200 East area (Figure 3-7) (PNNL-13788, 2002.). As stated in PNNL-13404 (2001), the water table gradient is too low to be used for determining flow direction or flow rate at the PUREX Plant cribs, immediately east of the IDF site.

Hydraulic conductivity directly beneath the IDF site was estimated from data collected during four slug tests at well 299-E17-21 and five slug tests of 299-E24-21. The interval tested at 299-E17-21 was the upper 7.8 meters (26 feet) of the unconfined aquifer from 101.3 to 109.1 meters (332 to 358 feet) depth. That portion of the aquifer is Hanford formation gravel, from 101.3 to 102.1 meters (332 to 335 feet) depth, and Ringold Formation unit E gravels, from 102.1 to 109.1 meters (335 to 358 feet) depth (PNNL-12257, 1999). The interval tested at well 299-E24-21 was entirely in the Hanford formation gravel sequence between 95.2 and 101.3 meters (312 and 332 feet) depth. The best-fit value to the data from 299-E17-21 indicated a hydraulic conductivity of about 68.6 meters (225 feet) per day

(PNNL-12257, 1999), and that from 299-E24-21 suggested a hydraulic conductivity of 75 meters (246 feet) per day (PNNL-13652, 2001).

Table 3-1: Water Levels in Groundwater Wells in the Vicinity of the IDF Site

Well	Measure date	DTW m[a]	WT elev m[b]	Ref elev m[c]
299-E13-10	03/14/02	101.7	122.5	226.31
299-E17-12	03/14/02	100.0	121.1	221.09
299-E17-13	04/12/01	97.7	122.6	220.34
299-E17-17	04/12/99	97.8	122.8	220.54
299-E17-18	10/03/02	98.5	122.3	220.76
299-E17-20	04/09/97	97.1	123.2	220.33
299-E17-21	04/23/98	100.4	122.7	224.26
299-E17-22	05/20/02	98.1	122.5	220.59
299-E17-23	05/20/02	101.6	122.2	223.84
299-E17-25	05/21/02	98.3	126.7	225.03
299-E18-1	03/14/02	98.2	122.4	220.65
299-E18-3	06/27/96	97.8	123.4	221.20
299-E18-4	06/27/96	97.7	123.4	221.05
299-E19-1	03/22/88	100.4	124.9	225.26
299-E23-1	03/14/02	96.0	122.4	218.39
299-E23-2	12/20/94	97.2	123.5	220.77
299-E24-4	08/10/98	90.6	122.9	213.47
299-E24-7	06/11/97	96.2	123.2	219.34
299-E24-16	10/04/02	97.7	122.3	220.02
299-E24-17	04/07/97	97.36	122.9	220.16
299-E24-18	10/02/02	98.0	122.3	220.35
299-E24-21	03/22/01	95.4	122.6	217.85

a DTW = depth to water
b WT elev = elevation of water table (meters above mean sea level)
c Ref elev = reference elevation (meters above mean sea level, North American Vertical Datam 88 reference), generally top of well casing.

Figure 3-1: Location of the IDF and Nearby Boreholes

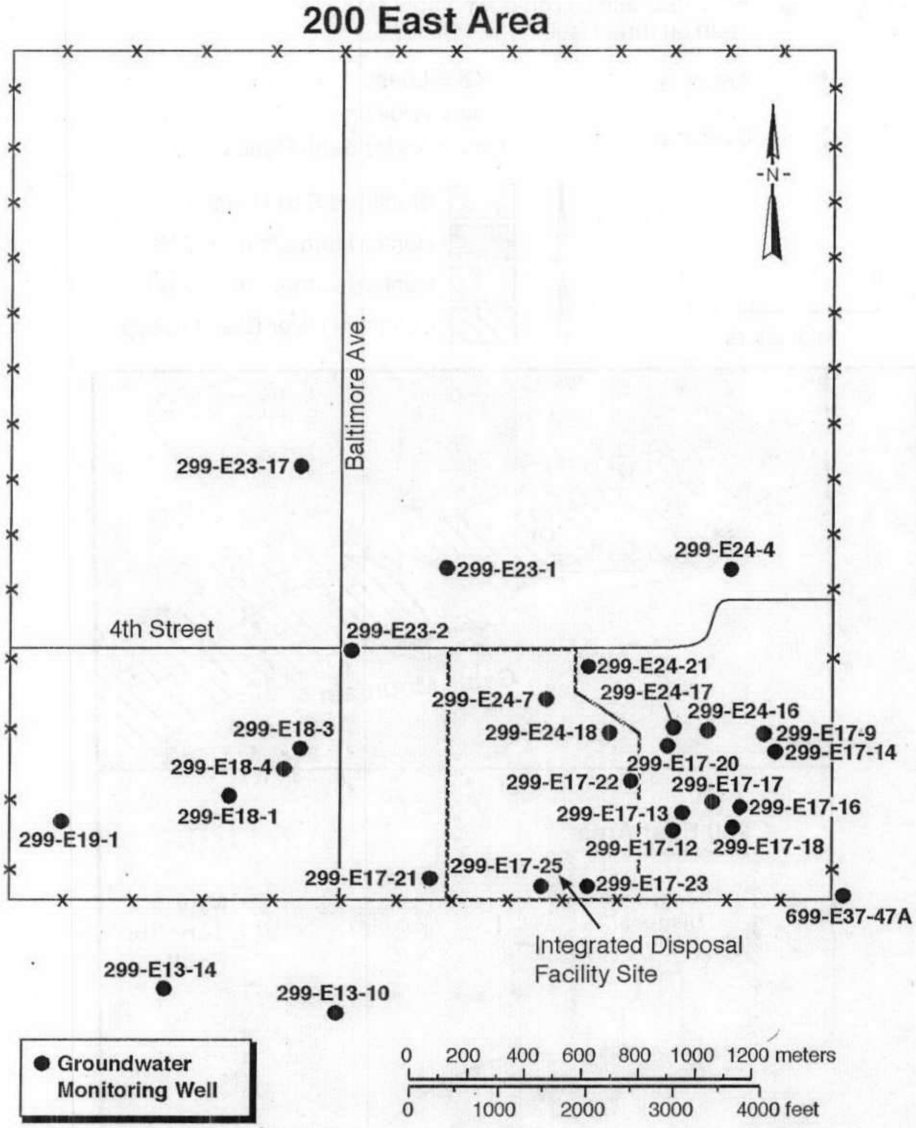


Figure 3-2: Geologic Map of the 200 East and 200 West Areas and Vicinity

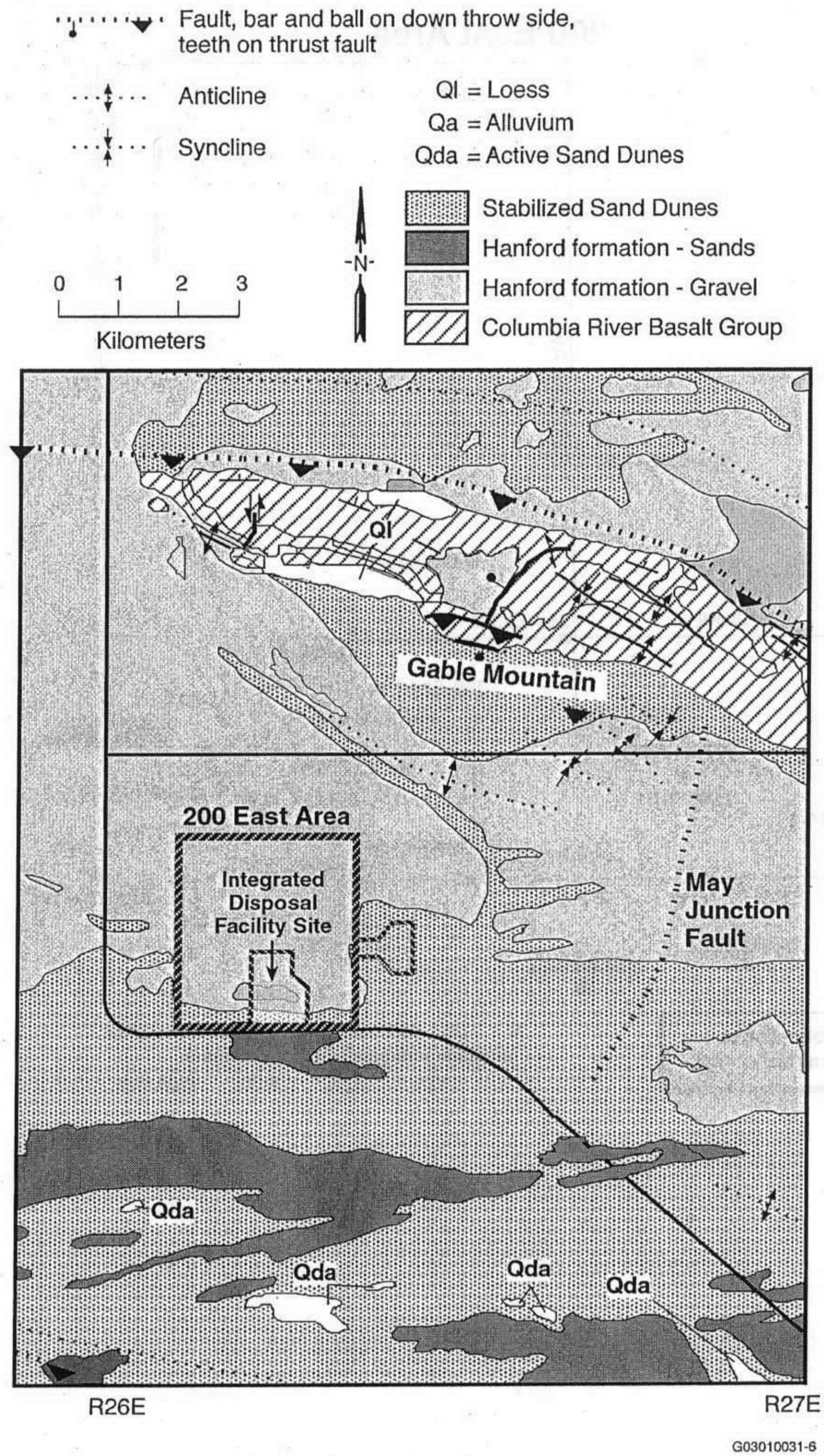


Figure 3-3: Stratigraphy of the Hanford Site

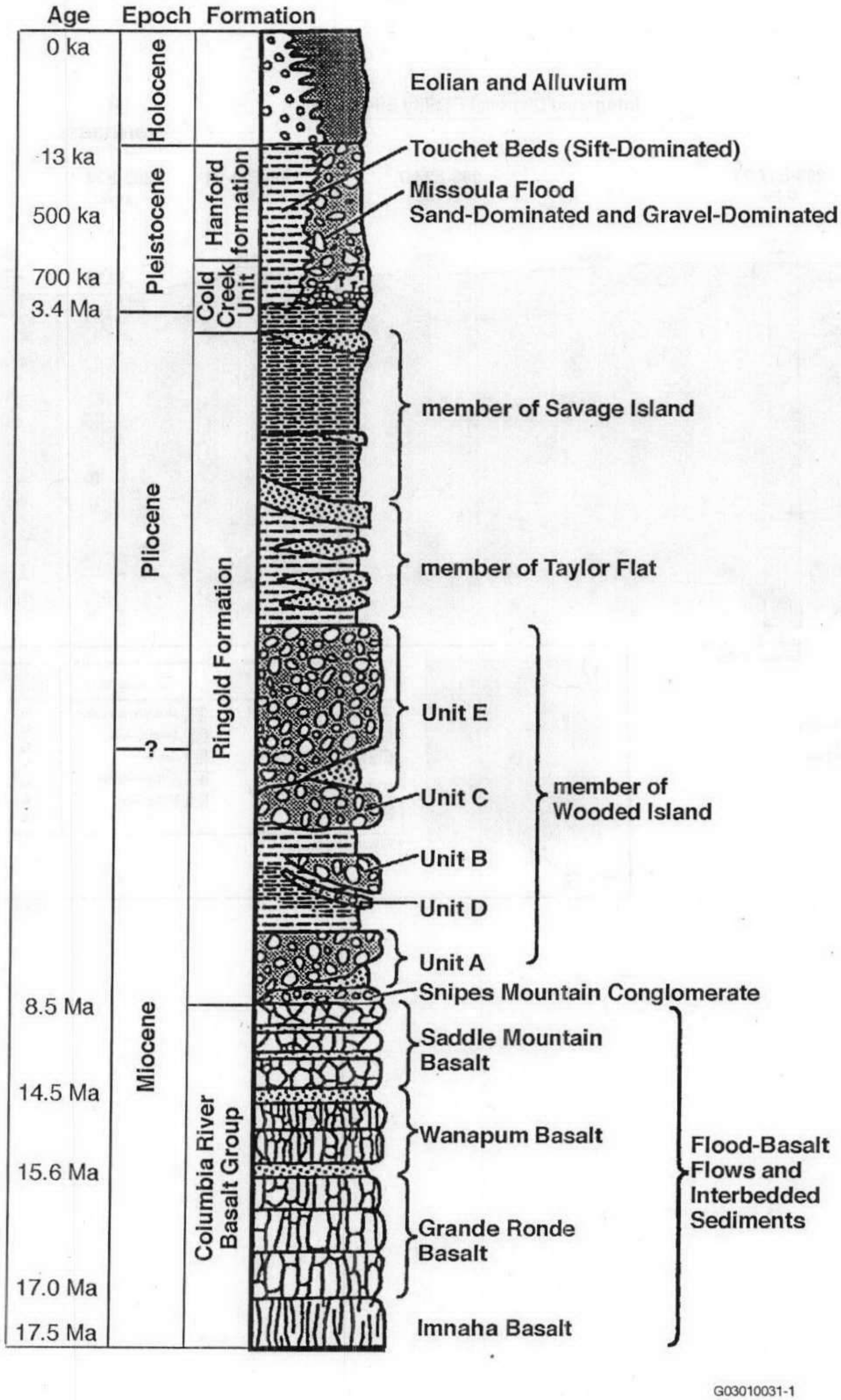


Figure 3-4: Cross-section through the IDF Site (refer to Figure 3-1 for boring exploration locations)

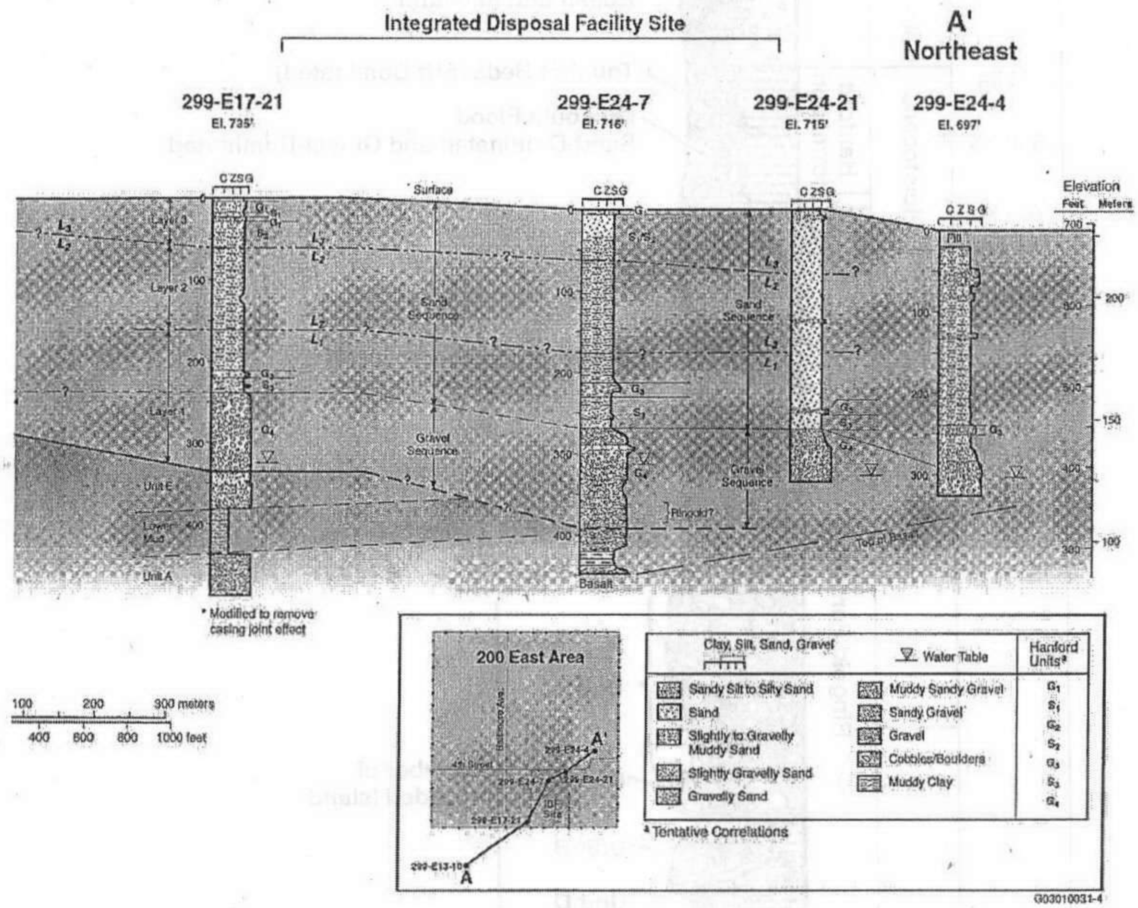
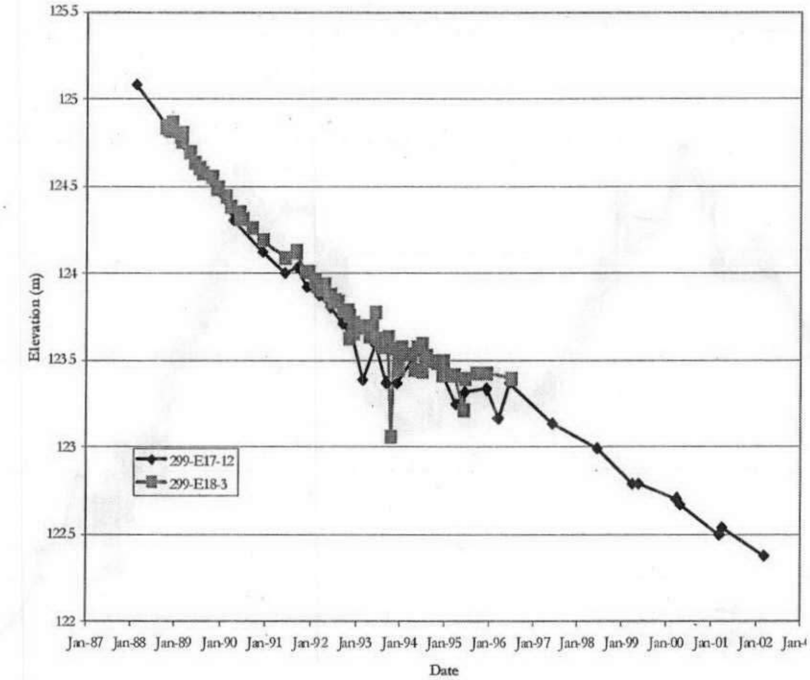


Figure 3-5: Hydrographs for Wells Near the IDF Site (1 and 2 of 3)



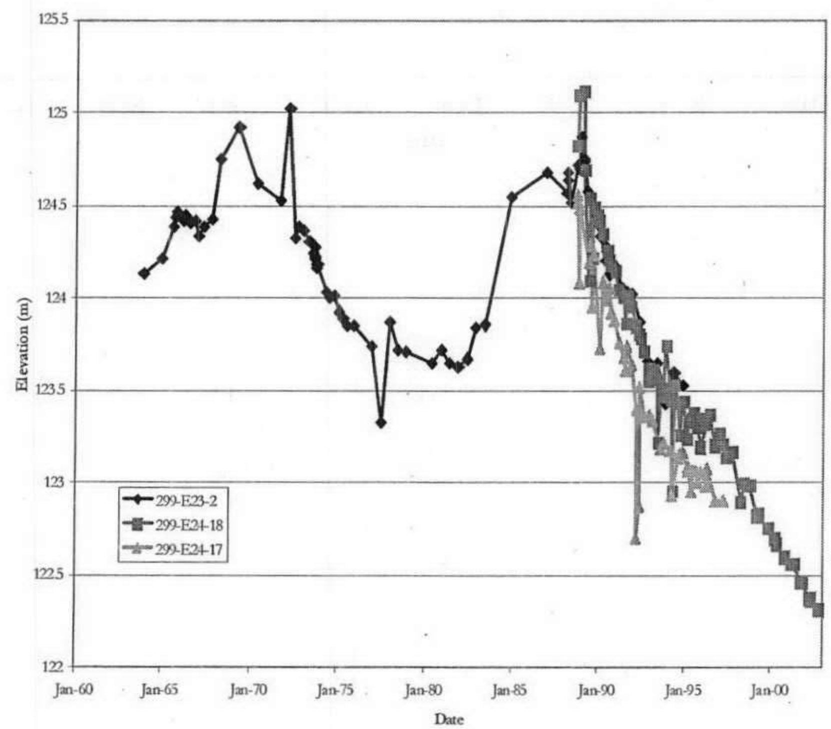


Figure 3-6: Hydrographs for Wells Near the IDF Site (3 of 3)

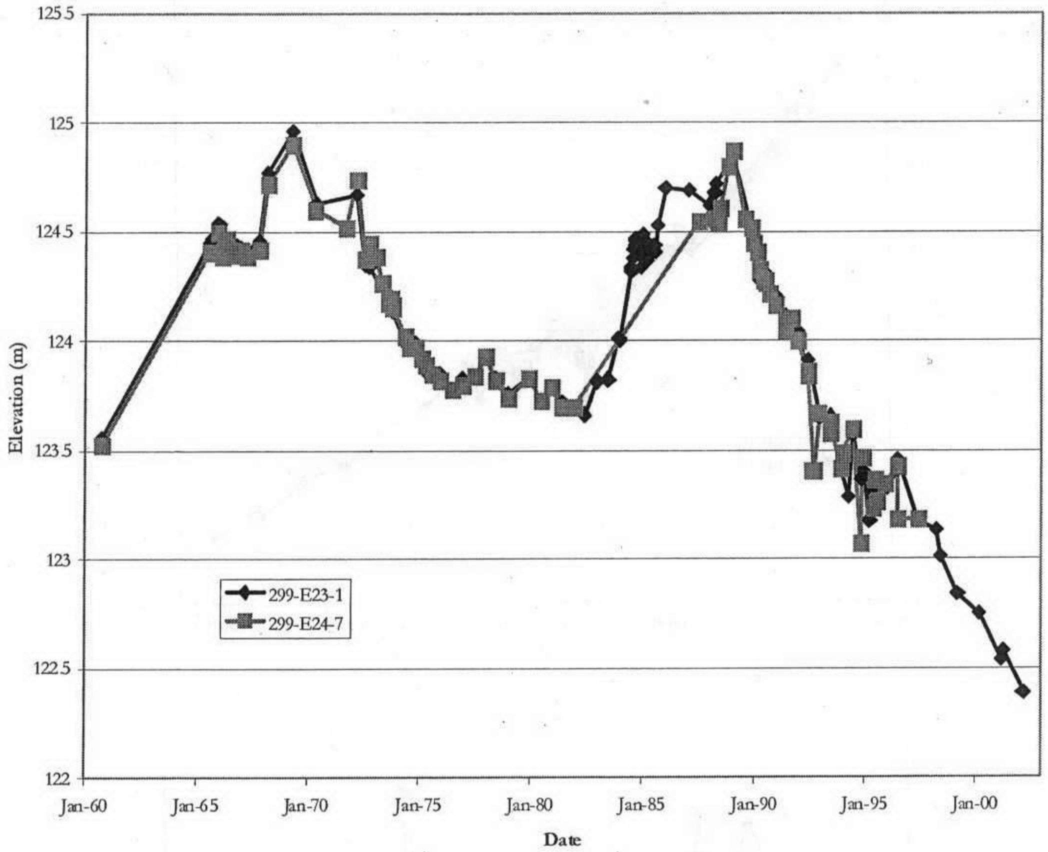
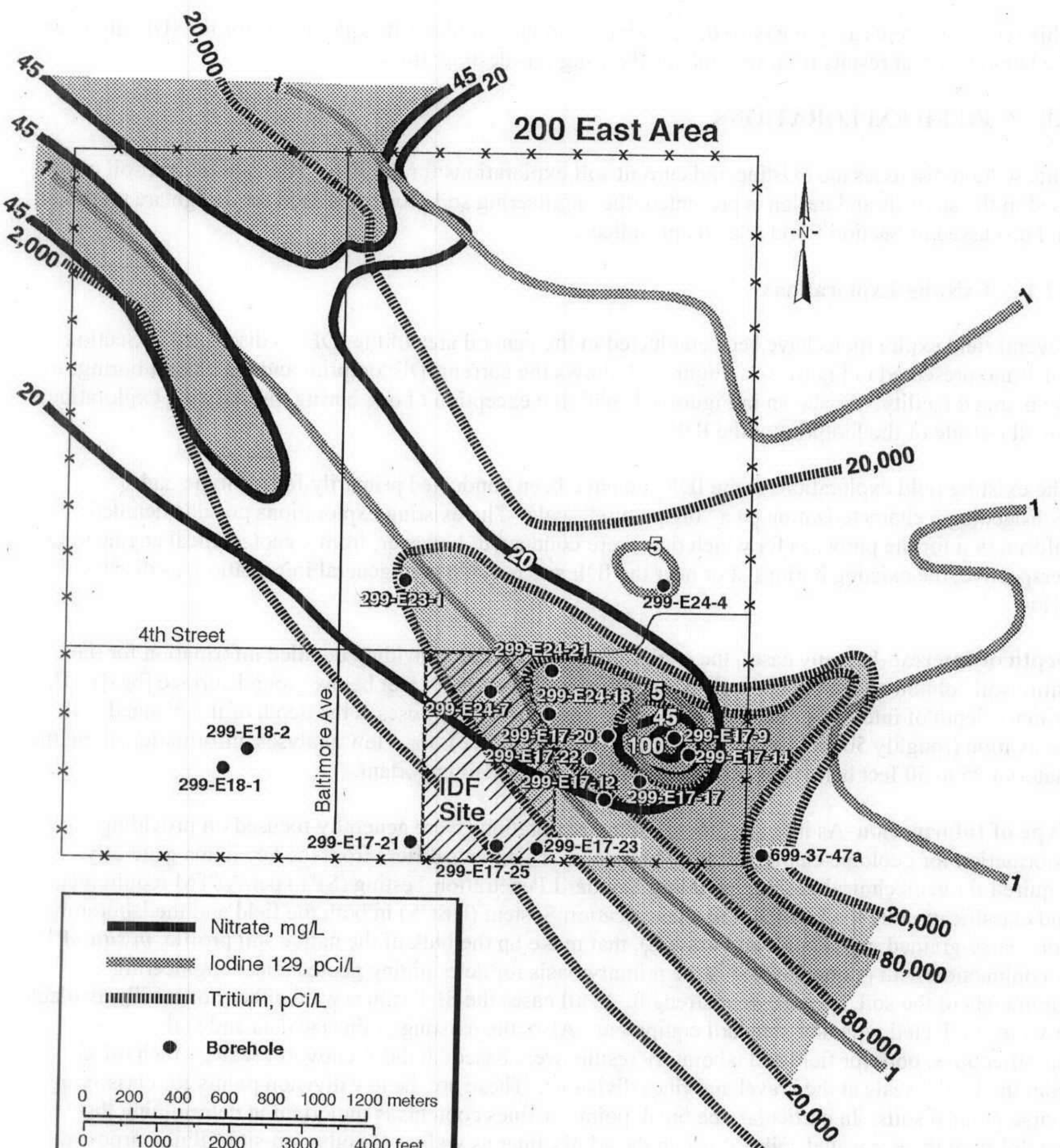


Figure 3-7: Contaminant Plume Map for the 200 East Area



4.0 SITE INVESTIGATION AND LABORATORY TEST PROGRAM

This section presents a summary of the existing, current, and planned explorations for the IDF, along with the laboratory test results for tests conducted during this design effort.

4.1 FIELD EXPLORATIONS

This section discusses the existing and current soil explorations for the IDF. The generalized soil profile used in the analysis and design is presented; the engineering soil properties used for design are presented and discussed in Section 5 and related appendices.

4.1.1 Existing Explorations

Several field explorations have been conducted in the general area of the IDF, as discussed in Section 3.4.1 and presented in Figure 3-1. Figure 4-1 shows the current IDF footprint and the closest borings to the planned facility. As shown in Figure 4-1, with the exception of one boring, the existing explorations are all outside of the footprint of the IDF.

The existing field explorations at the IDF site have been conducted primarily for geologic and hydrogeologic characterization on a "big picture" scale. The existing explorations provide detailed information for the purposes for which they were conducted; however, from a geotechnical engineering perspective, the existing borings at or near the IDF site provide only general information, as discussed below.

Depth of Interest–In many cases, the explorations focused on providing detailed information for the entire soil column above the bedrock at the IDF site (300 or more feet below ground surface [bgs]). The primary depth of interest for detailed engineering and design purposes is the depth of the planned cell excavation (roughly 50 feet below the existing ground surface); for a few analyses, information about the material 25 to 50 feet below the base of the excavation is also important.

Type of Information–As intended, the existing explorations were generally focused on providing information for geologic characterization purposes. This focus differs from the key items generally required for geotechnical design, including Standard Penetration Testing (SPT) per ASTM requirements and classification by the Unified Soil Classification System (USCS) in both the field and the laboratory. For coarse-grained soils (sands and gravels), that make up the bulk of the native soil profile, *in situ* SPT in conjunction with grain-size data is the primary basis for determining geotechnical engineering parameters of the soil, such as shear strength. In all cases the SPT values were either not readily available or were conducted with non-standard equipment. Also, the existing grain size data and soil classifications, both for field and laboratory results were based on the Wentworth scale, which differs from the USCS scale at the gravel and fines divisions. These are the key division points for classifying coarse grained soils. In particular, the break point for fines contents is important in determining the suitability of the excavated soils for use in the admix liner as well as for other on-site filling purposes. Many of the soils within the depth of interest for the IDF are near this classification break point.

Proximity to the IDF–As shown in Figure 4-1, in nearly all cases the explorations were located outside of the IDF footprint. The standard of practice for geotechnical engineering is to place explorations within or very close to the footprint of the proposed structure, if possible.

There have been several geotechnically focused explorations conducted for various projects at Hanford. The projects closest and/or most applicable to the IDF site are:

- The Grout Vault project, located approximately one-half mile east of the IDF site (Dames and Moore, 1988).

- The W-025 Project, a radioactive mixed-waste land disposal facility designed in accordance with RCRA Subtitle C design criteria, located several miles west of the IDF site (in Area 200W, Golder Associates, 1995, 1994a, 1994b, and 1988)

- The RPP-WTP, location approximately 1 mile east of the IDF site (Shannon and Wilson, 2000 and 2001)

These projects all provide geotechnical engineering information; however, the closest site is one-half-mile from the IDF. The standard of care for geotechnical engineering is to either use existing geotechnically based information that is at the site and/or conduct site and project specific explorations. This is to verify that the soil conditions at the site are either still valid (no changes since the time of the existing explorations) or are consistent with existing data.

4.1.2 Current Explorations

Due to the limits of the geotechnical specific data, a subsurface exploration plan specific to the Phase I portion of the IDF was proposed. The suggested locations for the exploration are shown in Figure 4-1. This exploration is currently in planning.

During this design effort, a limited surface sampling plan was conducted at the locations shown in Figure 4-1. The surface samples were taken from the upper 2 to 3 feet of soil, primarily to provide samples for admix testing (to determine if the soils were suitable as a base soil), as well as to help fill in for the absence of a full exploration program at the time of this design effort. As shown in Figure 4-1, samples were taken from primarily from the dune sand borrow area within the IDF footprint (SD-1 through SD-4) and the active sand borrow area (SD-5) to the east of the IDF footprint. One surface sample (SD-6) was obtained from within the IDF Phase I limits.

4.1.3 Site Stratigraphy

In the absence of a comprehensive site and project specific geotechnical engineering data, the existing and current data discussed above was reviewed to determine appropriate soil profile and geotechnical parameters for use in engineering analysis and design. The stratigraphy and soil properties were generally selected conservatively to account for the uncertainty in the subsurface information. The general soil stratigraphy beneath the Phase I section of the IDF was assumed to be:

- 10 feet of Dune (Eolian) sand, overlying

- 50 feet of Upper Hanford sand, overlying

- Lower Hanford sand to depth of interest

It is expected that a greater depth of Dune sand exists in the southern portion of the IDF footprint (note topographic change in the southern one-third of the IDF footprint in Figure 4-1).

The engineering properties and parameters assumed for these soil units were based on the information provided in the geotechnical reports listed in the previous section. The individual values are discussed in Section 5 and related appendices.

4.1.4 Future Explorations

It is recommended that a comprehensive, geotechnically focused exploration program be completed, prior to construction, to verify that the assumptions made for soil stratigraphy and engineering properties are valid. A more comprehensive set of explorations is currently being planned. The planned locations for the additional explorations are shown in Figure 4-1, and include three explorations within the Phase I footprint and one exploration in the proposed sand borrow area.

4.2 LABORATORY TESTING

A limited laboratory testing program was conducted, using the soils collected during the surface sampling program discussed in Section 4.1.3. These samples were used to perform the index testing, admix testing, and geosynthetics interface shear testing.

4.2.1 Index Testing

Index testing was performed to evaluate the basic index and classification properties of the soil obtained from surface sampling program. This testing was conducted to provide data for comparison with both the soils used for the W025 admix liner and also for other soils that are considered for use as the base soil for the IDF project, as the final design and construction proceeds.

The laboratory testing was conducted by Soil Technology, Inc., (STI) of Bainbridge Island, Washington, under subcontract to the Affiliate. Test assignment and coordination was provided by the Affiliate. Index testing included the following ASTM tests:

- ASTM D422 – Test Method for Particle-Size Analysis of Soils (grain size and hydrometer analyses)
- ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D1140 – Test Method for Amount of Material in Soils Finer then the No. 200 Sieve (P200 Wash)
- ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Efforts
- ASTM D2216 – Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

Compaction characteristics were also determined for a composite of the surface soils, as described in the next section.

4.2.2 Admix Testing Program

The admix testing program was developed to determine two key items:

- Percentage of sodium bentonite required to meet hydraulic conductivity requirements
- Appropriate moisture and density parameters to achieve the required hydraulic conductivity

Index testing of the admix soils was also conducted, as well as a consolidation test. The laboratory testing was conducted by STI. Tests were run in general accordance with the following:

- ASTM D422 – Test Method for Particle-Size Analysis of Soils (grain size and hydrometer analyses)
- ASTM D698B – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort

- ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Efforts
- ASTM D2216 – Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
- ASTM D2435 – Test Method for One-dimensional Consolidation Properties of Soils
- ASTM D4318 – Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)
- ASTM D5084 – Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

The base soil for the admix testing was created by compositing SD-1 through SD-4 from the surface sampling program. This composite did not include SD-5, taken at the base of the existing sand borrow area (lower elevation than the other samples) that has slightly different properties than the remainder of the surface samples. SD-6 was not included at the time of the admix testing because it is not within the footprint of the planned borrow area. The base composite sample was labeled as COMP-1. This composite was then used to create the two other soils for admix testing:

- COMP-2: COMP-1 base soil mixed with 8 percent bentonite
- COMP-3: COMP-1 base soil mixed with 12 percent bentonite

Moisture and density testing was conducted on all of the composite samples.

The initial hydraulic conductivity testing was conducted using eight and 12 percent bentonite (by weight), based on the results of the admix testing program conducted by Golder for the W025 Project (Golder, 1991b). The target laboratory hydraulic conductivity was less than 10^{-8} cm/sec when permeated with water. Testing was not conducted with leachate, as no actual leachate exists for the planned waste at this time. Golder Associates used a synthetic leachate to perform compatibility testing on the admix liner. Based on these results, they increased the bentonite percentage from 8 to 12 percent, hence the use of these values in these tests. Because the base soils are expected to be similar to that used by Golder for the W025 landfill, and until a more refined characterization of the IDF leachate is developed, the compatibility testing performed for the W025 project was considered applicable to the IDF project.

Hydraulic conductivity testing was performed on all samples in flexible wall triaxial cells with backpressure saturation, in general accordance with ASTM D5084. An effective confining stress of 5 pounds per square in (psi) was applied to each test cell. Appendix B.1 includes the details for the test, including the inflow and outflow data used to confirm that each test had obtained a steady-state hydraulic conductivity value.

After the initial hydraulic conductivity testing was completed, additional samples were set up to determine the range of moisture and density parameters that are expected to produce the required hydraulic conductivity in the field.

As noted above, the samples used for the testing were gathered from the surface sampling program. Once a more comprehensive exploration program is conducted within the IDF footprint, the suitability of the soils within the excavation below a depth of 5 feet (upper 2-3 feet) can be examined for use as a base soil for the admix.

4.2.3 Geosynthetics Interface Shear Testing

A limited soil-to-geosynthetic interface shear testing program was conducted to determine the interface shear values between the operations soil and the composite drainage net (CDN), and the admix liner soils and the high-density polyethylene (HDPE). These interfaces are site specific because of the unique nature of the soils, hence their behavior in interface shear. The testing was conducted by Precision Geotechnical Laboratories in Anaheim, California. Soil samples collected during the surface sampling program were used for testing; GSE Lining Technologies, Inc. based in Houston, Texas provided the geosynthetics for testing.

The interface shear tests were conducted in general accordance with ASTM D5321–*Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.* The tests were conducted for both low (100 to 500 psf) and high (1000 to 8000 psf) normal stress levels, to account for the variation in normal stresses that will be applied across the lining system in the final landfill configuration. Both the peak and residual strength values were determined during testing. Additional details for the tests are presented with the test results in Appendix B.2.

Asperity testing was also conducted on the textured HDPE geomembrane, in general accordance with GRI-GM12 – *Asperity Height of Textured Geomembrane*. The purpose of the asperity testing was to establish a baseline roughness of the texturing of the HDPE geomembrane and for future assessments of the interface shear strength of other textured HDPE geomembrane products (e.g., from other manufacturers).

Site-specific interface shear testing was not conducted for geosynthetic-to-geosynthetic (such as CDN to geosynthetic clay liner [GCL]) interfaces in this phase of design, as these values are primarily a function of the manufactured product properties. A database of values for geosynthetic-to-geosynthetic interface testing was used to determine the appropriate interface shear values for design. During construction, the actual materials used on the site will be tested as part of the construction QC/QA, to ensure that the installed materials used onsite meet or exceed the interface shear strength values used in the design.

4.3 LABORATORY TEST RESULTS

The results of the laboratory testing programs are summarized below and presented in Appendix B.1 and Appendix B.2.

4.3.1 Index Testing

The results of the index testing for the surface samples are presented in Table 4-1. The test results are included with the admix liner soils test results in Appendix B.1. Results of the index testing indicate that the grain size analyses for near-surface soil samples from locations SD-1 through SD-6 correlate well with data from the W025 base soil material. The W025 base soil was a dune sand (Eolian deposits) obtained from the upper 15 feet of site excavations. As discussed in Section 5.4, based on the results shown below and due to the limited nature of the near surface soil samples, the base soil is limited to the upper 5 feet of material excavated from the dune sand borrow area or the Phase I site excavation.

Table 4-1: Results of the Base Soil Index Testing

Test	Sample #	% Gravel	% Sand	% Fines	OMC, w_{opt} (%)	MDD, γ_{dmax} (pcf)
Grain Size Testing	SD#1			22.5	--	--
	SD#2		72.2	27.8	--	--
	SD#3			17.5	--	--
	SD#4		78.1	21.9	--	--
	SD#5	2.4	58.5	39.1	--	--
	SD#6		79.5	20.5	--	--
Standard Compaction	SD#6	--	--	--	14	106.6

OMC = optimum moisture content
MDD = maximum dry density

4.3.2 Admix Liner Soils Test Results

The results of the testing program conducted on the admix liner soils are summarized in Tables 4-2 and 4-3 and presented in detail in Appendix B.1. The associated placement and testing requirements during construction are also discussed in detail in Section 5.4.

Table 4-2: Results of the Admix Hydraulic Conductivity Testing

Sample ID	OMC (%)	MDD (pcf)	Remolded MC (%)	Remolded Wet Density (pcf)	Relative Compaction (%)	Saturated Hydraulic Conductivity (cm/sec)[a]	Gradient
COMP2-1	12.8[b]	117.2[b]	13.5	127	95	$2x10^{-8}$	11
COMP2-2	12.8[b]	117.2[b]	17.7	123	89	$4x10^{-8}$	10
COMP3-1	13.0[b]	115.5[b]	13.2	124	95	$<1x10^{-8}$	10
COMP3-2	13.0[b]	115.5[b]	17.4	122	90	$<1x10^{-8}$	10
COMP3-3	10.0[c]	126.3[c]	10.3	136	98	$<1x10^{-8}$	12
COMP3-4	10.0[c]	126.3[c]	14.2	139	96	$<1x10^{-8}$	10
COMP3-5	10.0[c]	126.3[c]	8	130	95	$<1x10^{-8}$	18
COMP3-6	13.0[b]	115.5[b]	10	115	91	$1x10^{-8}$	21
COMP3-7	10.0[c]	126.3[c]	10	123	89	$<1x10^{-8}$	20
COMP3-8	13.0[b]	115.5[b]	11	119	93	$<1x10^{-8}$	16

Abbreviations: OMC = optimum moisture content MDD = maximum dry density pcf = pounds per cubic foot
MC = moisture content
COMP 2 samples had 8 percent bentonite.
COMP-3 samples had 12 percent bentonite.
Average saturated hydraulic conductivity using tap water
Based on standard Proctor compaction curve (D698).
Based on modified Proctor compaction curve (D1557)

Table 4-3: Results of Admix Liner Soils Index Testing

Test	Sample #	% Gravel	% Sand	% Fines	LL (%)	PI (%)
Grain Size Testing	COMP-1	--	77.5	22.5	--	--
	COMP-2	--	70.6	29.4	--	--

Table 4-3: Results of Admix Liner Soils Index Testing

Test	Sample #	% Gravel	% Sand	% Fines	LL (%)	PI (%)
	COMP-3	--	68.7	31.3	--	--
Atterberg Limits	COMP-2	--	--	--	40	17
	COMP-3	--	--	--	54	32

LL = Liquid Limit
PI = Plasticity Index

Consolidation testing conducted on the admix liner soils is presented with the rest of the results in Appendix B.1. This results of this test were used for the settlement analysis discussed in Section 5.3.1.

4.3.3 Geosynthetics Interface Shear Tests

The results of the geosynthetic testing program are presented in Table 4-4; the results of the asperity are shown in Appendix B.2. The results are discussed in detail in Sections 5.1.1 and 5.1.3, and their related appendices (Appendix C.1.a and C.1.c, respectively).

Table 4-4: Summary of Geosynthetic Testing

	Test	Peak Friction Angle (°)	Peak Cohesion (psf)	Residual Friction Angle (°)	Residual Cohesion (psf)	Asperity	Comments
Low normal stress	Operations Soil-CDN Interface	29.6	205.9	24.6	205.4	--	– Test #1 – dry density = 92 pcf – w_c = 8.7%
Low normal stress	Admix Soil-HDPE Interface	33.3	94.4	33.5	56.8	--	– Test #3 – dry density = 110 pcf – w_c = 14%
High Normal Stress	Operations Soil-CDN Interface	28.3	283.9	28	240.8	--	– Test #2 – dry density = 92 pcf – w_c = 8.7%
High Normal Stress							–
High Normal Stress	Admix Soil-HDPE Interface	25.4	400.7	20.3	525.3	--	– Test #4 – dry density = 110 pcf – w_c = 14%
	Textured HDPE Asperity	--	--	--	--	23.5	Average value of two test results of 22 and 25.

As the final design progress and additional information is gathered for the admix soils and the operations soils, these results should be verified with additional testing. Testing during full scale construction is also planned to verify that the materials used in construction, both soils and geosynthetics, produce interface shear values at or greater than those used for design.

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5.0 ENGINEERING ANALYSIS

This detailed Design Report finalizes the design for the landfill liner system, the leachate removal system, and the LDS. Engineering analysis components for each of these critical systems is presented in this section. A general description of system components is located in Section 5.6.1, that presents the primary and secondary liner systems that make up the major layers of the landfill (detailed system descriptions are presented in Section 6).

In preparation of the IDF design, a number of design requirements and criteria as presented in Section 2 have been considered. Compliance with these design requirements is provided in Appendix A. The specific criteria evaluated for the IDF design included:

- Slope stability
- Landfill bearing capacity
- Settlement and uplift analyses
- Admix liner
- Geosynthetic liner design
- Liner systems/leachate compatibility
- Drainage layer
- Leachate production
- Leachate collection system
- Surface stormwater
- Action leakage rate
- Building systems analyses
- Civil grading

5.1 SLOPE STABILITY

Slope stability for the IDF landfill was examined for liner veneer (side slope) stability, earthwork stability, waste/fill global stability. The analyses for each of these cases are summarized in the sections below; Appendices C.1.a through C.1.c present the analyses and results in detail.

5.1.1 Liner Veneer (Side Slope) Stability

The veneer stability of the liner system on the side slopes was evaluated for the period prior to waste filling. The analysis examined the potential for sliding of the drainage and operations layers on the liner system before waste is placed.

The analyses were conducted using the weakest of the interface strengths of the various lining system components. The interface strengths were determined from regression analyses of data gathered from various sources, including site-specific test data completed to date. Based on the data (presented in Appendix C.1.a), the critical interface is the textured HDPE/CDN interface. Properties of the cover soil (operations layer) were determined from laboratory testing to date on the materials expected to be used for the operations layer.

Four loading conditions were examined:

- Dead load: self-weight of the lining system (including the first operations layer)
- Dead load + Equipment: self-weight of the lining system with an equipment load
- Dead load + Seepage: self-weight of the lining system with a seepage load (to account for fluid head in the leachate collection system); seepage loads were based on results from the leachate system hydraulic analyses
- Seismic Loading: self-weight of the lining system with seismic loading

The results of the analyses show that the lining system is stable for the conditions analyzed and no anchorage forces are required to meet the minimum factors of safety (1.5 for dead load only; 1.3 for equipment and seepage loading). A minimum interface friction of 25 degrees and cohesion of 0 psf is required to meet the minimum acceptable factors of safety. The slopes are also considered to be stable under seismic loading, based on comparing the calculated yield acceleration and with the design acceleration values provided in the design criteria by CH2M HILL (September, 2002), using the hazard classification assigned to the overall facility.

The critical interface friction values will be verified during construction to ensure that the system will be stable. The analyses and results are presented in full detail in Appendix C.1.a.

5.1.2 Earthwork Stability

The earthwork stability analysis covered the following three cases:

- **Excavation Case:** This case covers the stability of the landfill slopes immediately after excavation and before placement of the lining system. Only static loading was considered since this is an interim configuration that will only exist for the construction period.
- **Ramp Case:** This case covers the stability of the landfill slopes and access ramp at the south end of the cell, including equipment loading on the ramps. Both static and seismic loading were examined, as the access ramps are expected to be in use for a period of at least 10 years.
- **Dike Case:** This case covers the stability of the perimeter dike (shine berm and access road) after construction of the dike and before final closure of the landfill. Both static and seismic loading were examined, since the perimeter dike may be in place until the final cover system is completed (greater than 10 years).

Properties for the native soils are based on existing information, as a site-specific geotechnical engineering investigation program has not yet been completed for the IDF facility. When this investigation is completed, the results of this analysis (and any others that rely on the properties of the native soils) will be verified. Geometry used in the analyses is based on the civil plans (generally 3H:1V slopes with a few short 2H:1V slopes).

The results of the analyses show that the planned configurations of the landfill are stable under static loading (factor of safety [FS] greater than 1.3 and 1.5, depending on the case analyzed); the configurations are also considered seismically stable based on the criteria for the Hanford site. Full details on the analysis method, the input data, and the results are presented in Appendix C.1.b.

5.1.3 Waste/Fill Global Stability

This analysis examined the following conditions:

- **Phase I Full Build-Out:** This case examined the stability of the waste mass in full build-out of the Phase I waste cell. The critical stability examined was the waste sliding on the lining system. Both static and seismic loading conditions were examined.

- **Final Configuration:** This case examined the stability of the waste mass at the final configuration (entire IDF landfill completed) along the edge of the cover system. Only static loading conditions were examined, since this system is not being designed as part of the current effort.

Interim filling conditions and the internal stability of the waste mass were not examined. The internal waste mass stability will primarily be a function of the filling methodology. Possible filling plans for the waste are currently being developed.

For the analysis of the full build-out of Phase I, the critical interface strengths in the lining system were determined in the same way as for the veneer stability (regression analyses of existing and site specific testing data). A combination of peak and residual strengths were used, based on methodology currently being employed in the state of the practice. A final check was also made to confirm that the use of residual strengths in all locations resulted in a factor of safety greater than 1.0.

The results show that the system is stable for the configurations analyzed and for the interface friction values available at the time of the analyses (FS greater than 1.5 in static loading and yield acceleration greater than the 10,000-year event). The system also has a FS greater than 1.0 for the case of residual strengths in all locations. The critical interfaces are the HDPE-CDN on the side slopes (using residual strengths) and the HDPE-GCL on the base liner (using peak strengths) and the internal GCL strength (using residual strengths). These results should be verified when additional site-specific test data becomes available prior to and during construction.

Also, it should be noted that for the full Phase I build-out configuration, the most critical case appears to be a failure surface that is allowed to propagate through the waste mass. As noted previously, the waste mass was considered internally stable for this design effort. During final operations planning, the internal stability of the waste will be examined in conjunction with the proposed waste filling plan.

For the final configuration with the cover in place, the preliminary geometry and assumed cover system properties show that the configuration is stable under static loading (FS greater than 1.5) and the critical failure does not intersect the waste mass. Stability of the final configuration under both static and seismic loading should be examined in more detail as the final design develops for the final closure of the entire IDF facility.

A full discussion of the methodology, input data, and the results is presented in Appendix C.1.c.

5.2 LANDFILL BEARING CAPACITY

5.2.1 Subgrade Soil

Based on the available geotechnical data from other projects (as discussed in Section 4), the strength of the native subgrade soils beneath the landfill is expected to be greater than that for the operations layer or any of the liner system components. Greater strengths equate to higher bearing capacities, and hence, the bearing capacity of the subgrade soils within the landfill cell was not determined directly as they are not the controlling factor.

The bearing capacity of the subgrade soils beneath the supporting structures adjacent to the landfill cell was determined for the structural analyses, discussed under Section 5.12.1–Geotechnical Design Parameters, and the results of the analyses are presented in Appendix C.11.a.

5.2.2 Liner Soils

The soil layers in the lining system include the operations layer, drain gravel, and the admix liner soils. The admix liner soils will be placed beneath the geosynthetic lining system, and as such, loading on the admix liner soils is limited to the allowable loads for the GCL. The allowable loads for the GCL are much less than what the bearing capacity of the admix liner soils would be (the admix soils have much higher strengths, particularly for bearing pressures). The drain gravel will be placed just above the lining system; the shear strength and associated bearing capacity are also much greater than the GCL allowable values.

At the time of these calculations, structures that would cause bearing pressure were not yet determined. Hence, the bearing capacity for the operations soils was calculated for foundation widths from 1 to 10 feet and for 2 different shapes (square and strip). Properties for the operations soils were based on laboratory testing conducted to date; these properties will be verified during construction to ensure that the analyses results are valid.

For a factor of safety of 3, the allowable bearing capacities for the operations layer are presented in Table 5-1.

Table 5-1: Operations Soil Bearing Capacities

B, Foundation Width (feet)	q_{all}, square foundation (tsf)	q_{all}, strip foundation (tsf)
1	0.20	0.33
5	1.0	1.6
10	2.0	3.3

As the operations plans are further developed, these values can be updated for the planned structures (such as barrier walls). Details of the analyses are presented in Appendix C.2.

5.3 SETTLEMENT AND UPLIFT ANALYSES

5.3.1 Settlement Analysis of Liner Foundation

The long term settlement of the soils supporting the geosynthetic liner system was estimated based on the maximum loading expected in the landfill at the final IDF completion. The two soil units examined were the admix liner soils and the native subgrade soils. For the admix soils, data from laboratory consolidation testing performed on samples available at the time of the analysis were used to determine the estimated settlements. Elastic methods were used to estimate the settlements of the subgrade soils.

As detailed in Appendix C.3, the estimated long term settlement over the lifetime of the landfill is 2.7 feet under the maximum loading.

5.3.2 Subsidence and Sinkhole Potential

Subsidence of undisturbed foundation materials is generally the result of dissolution, fluid extraction (water or petroleum), or mining. Subsidence is not expected to occur based on the following:

- The soils underlying the IDF are generally dense, coarse-grained, and well-graded sands and gravels that will not be subject to piping effects that could transport soil and result in subsidence. Also, sands and gravels are generally not susceptible to dissolution.
- The groundwater level is deep and will not affect bearing soils.
- The bedrock is basalt (volcanic), which is not generally susceptible to dissolution.
- No mining or tunneling has been reported in the areas beneath or surrounding the site for the IDF.

Borings in and around the IDF have not identified any soluble materials in the foundation soils or underlying sediments. Consequently, the potential for any sinkhole development will be negligible.

5.3.3 Uplift Potential

The potential for uplift of the composite liner system is very low. The seasonal high-water level is over 200 feet below the base of the base of the landfill cell, so no external hydrostatic pressure is expected from this source. Perched groundwater is not expected to occur due to the absence of continuous aquitards (such as a clay layer) within the coarse-grained native soils at the IDF site. Any infiltration that does occur is expected to rapidly percolate to deeper soil layers.

Gas pressures are also expected to be negligible, as no gas-generating material (i.e., organic material) is expected in the foundation soils. Also, the subgrade soils are coarse grained and unsaturated, so any gas that might occur is expected to be rapidly dissipated.

5.4 ADMIX LINER

5.4.1 Mix Design

WAC 173-303-665(2)(h)(i)(B) requires that the lower component of a composite bottom liner be constructed of compacted soil material with an in-situ hydraulic conductivity no greater than 10^{-7} cm/sec. Because of the lack of naturally occurring soils on-site that could achieve this requirement, a test program was developed to determine the admixture requirements for a mixed soil design using on-site base soil from either the Phase I excavation or dune sand borrow area (see Drawing H-2-830826 for location) and sodium bentonite. Details of the base soil field exploration and admix testing program are provided in Section 4.

The results of the limited field exploration for base soil samples and subsequent admix testing program discussed in Section 4 show that a nominal bentonite content of 12 percent will meet the laboratory target hydraulic conductivity of less than 10^{-8} cm/sec when permeated with water. The laboratory target was established based on results of the soil liner/leachate compatibility study (Golder Associates, 1991b) for the W025 landfill. Details of Golder's study are discussed in Section 5.6. The W025 study concluded that the bentonite content of the admix should be increased from 8 percent (the minimum bentonite percent needed to achieve the required hydraulic conductivity) to 12 percent, to provide adequate resistance against high inorganic concentrations in the synthetic leachate for the W025 project. Index laboratory testing on the limited field exploration at the IDF site (surface sampling) established that the base soil for the IDF was similar to the W-025 project, as discussed in Section 4. Thus, until a more refined characterization of the IDF leachate is developed, the compatibility testing from the W025 testing is applicable to the IDF mix design.

Once initial hydraulic testing confirmed that an admix with 12 percent bentonite content could achieve the laboratory target value, additional samples were set up to evaluate a range of moisture and density parameters and their effect on hydraulic conductivity. The additional hydraulic conductivity tests were performed to define moisture content-density requirements for a range of compactive energy, as outlined by Daniel and Benson (1990). This data was being used to develop an "acceptable" zone of moisture and density for use by QC personnel during construction. The acceptable zone for the 12 percent admix is presented along with the admix design laboratory test results in Appendix B.1.

The acceptable zone was developed based on samples that achieved a hydraulic conductivity of less than 10^{-8} cm/sec. A lower bound of 95 percent relative compaction, based on Standard Proctor (ASTM D698) compactive effort, was established to ensure adequate shear strength levels. As indicated in the technical specifications (see Section 02666), the moisture-density range of the compacted admix shall lie within a trapezoidal-shaped field with the following corners:

Moisture Content (%)	Dry Density (pcf)
8	126
14	126
12	110
19	110

Note that the minimum dry density of 110 listed above corresponds to approximately 95 percent of the maximum dry density for the admix, as measured by ASTM D698.

5.4.2 Placement and Testing

The moisture-density requirements developed as part of the admix testing program will be included in the specifications for the admix liner (see discussion in Section 5.4.1, and technical specifications, Section 02666). The intent of the placement technical specifications is to help ensure that the admix liner will meet an in-place performance specification for hydraulic conductivity of less than 1×10^{-7} cm/sec. The contractor is responsible for developing and implementing compaction means and methods that will produce the required relative compaction.

The recommended nominal bentonite percentage (12 percent) and moisture-density parameters for the admix liner have been developed with a one order of magnitude factor of safety between laboratory and field values for hydraulic conductivity. The factor of safety is expected to account for two issues: (1) variations in the hydraulic conductivity between the laboratory soil amendment study and full-scale production, and (2) the laboratory samples were permeated with water rather than leachate, which could lead to a difference in the field hydraulic conductivity. However, factors such as base soil variability at the borrow source and field placement and construction are difficult to quantify until full-scale production begins for the admix liner. A test pad will be constructed as part the IDF construction to model the full-scale production. The purpose of the test pad is to determine acceptable processing, placement, and compaction methods that will produce a low-hydraulic conductivity admix liner with an *in situ* hydraulic conductivity of 10^{-7} cm/sec or less. The bentonite percentage and moisture content/density range may be modified if the preconstruction testing performed on the test pad indicates an *in situ* hydraulic conductivity greater than 10^{-7} cm/sec. Construction QA sampling and testing for the test pad is described in the Detailed Design Cell 1 Construction QA Plan (CH2M HILL, March 2004).

5.4.3 Freeze/Thaw

Compacted soil liners, such as the IDF admix liner, are known to be vulnerable to large increases in hydraulic conductivity due to freeze/thaw cycling; current data suggests that compacted soil bentonite admixtures may not be as vulnerable to damage as true clay liners (Kim and Daniel, 1992; Benson and Othman, 1993; Kraus et al., 1997). Existing laboratory data indicate that GCLs are less susceptible to damage from freeze/thaw conditions and therefore, do not undergo increases in hydraulic conductivity (Hewitt and Daniel, 1997; Kraus et al., 1997).

In order to provide adequate freeze/thaw protection for the admix liner and avoid potential damage to the GCL a protective soil cover can be used. The thickness of the protective soil cover should exceed the predicted freeze depth. For the IDF, protective soil cover is provided by the operations layer on the side slope (3 feet) and the drain gravel and operation layer (4 feet total) on the bottom liner.

The analysis was performed on the IDF lining system operations layer to determine the freeze depth or frost penetration for a probable freezing season during the 10-year expected period of waste filling. Both a 10-year return period (90 percent probability on non-exceedance) and 20-year return period (95 percent probability on non-exceedance) air freeze index (AFI) were used to estimate maximum frost penetration depth in the operations layer. If the maximum frost penetration depth was less than the 3-foot minimum thickness operations layer over the lining system, the proposed operations layer thickness would be considered as adequate protection for exposure of the lining system to freeze-thaw cycles.

For the 10-year return AFI, the maximum freeze depth is estimated at 17 inches. For the 20-year return AFI, the maximum freeze depth is estimated at 21 inches. The maximum estimated freeze depths for both the 10-year and 20-year return period freezing seasons indicate that the proposed cover soil thicknesses provide more than adequate protection for the underlying admix liner and GCL from potential damage when subject to freeze-thaw cycles. Details of the freeze depth calculations are included in Appendix C.4.

5.5 GEOSYNTHETIC LINER DESIGN

5.5.1 Geomembrane Liner Tension Caused By Thermal Contraction

The HDPE geomembrane for IDF lining system will be subject to temperature-induced tensile strain from expansion/contraction as the geomembrane is exposed to temperature fluctuation.

Strain on the liner was calculated using published values for the coefficient of linear thermal expansion for HDPE geomembrane (Koerner, 1998) and applying this to the maximum slope length. The maximum length is measured from the top of the slope, where liner is anchored, to the toe of the 3H:1V side slope. This is a conservative approach, as using the maximum slope length results in the maximum amount of expansion and strain on the liner. Additionally, a conservative temperature change of 40 degrees C (104 degrees F) was used in the analysis.

The maximum liner strain was estimated to be less than 0.5 percent, based on a maximum temperature change of 40 degrees C (104 degrees F). The estimated maximum of slack in the liner on the side slope is 8.6 inches. The corresponding amount of temperature induced stress is 566 psi. See Appendix C.5.a for supporting calculations.

As shown in the technical specifications, Section 02661 (Table 1), the elongation at yield for the geomembrane that will be used in the liner system is at least 12 percent, with a minimum tensile strength at yield of 2,000 psi. Therefore, the maximum anticipated strains are well below the yield tensile strain and stress for the HDPE geomembrane, and temperature-induced strain will have no adverse impact on lining system function.

It should be noted that temperature-induced strain is only applicable during the construction period when the HDPE geomembrane is exposed to temperature fluctuation. Once covered with 3 to 4 feet of cover soils (drain gravel and operations layer), the ambient temperature at the surface of the geomembrane will be more controlled and not subject to fluctuation.

During installation, care must be taken to allow for expansion/contraction of the HDPE geomembrane to minimize the development of wrinkles that could become future stress points under soil and waste loading. The technical specifications (see Section 02661) provide requirements for control of wrinkle development during liner deployment, including the limitation of working when the temperature is below 0 degrees C (32 degrees F) or above 40 degrees C (104 degrees F) without implementing installation procedures that address the environmental conditions.

5.5.2 Liner System Strain Due To Settlement

The barrier components (geomembrane and GCL) for the IDF lining system will be subject to settlement-induced tensile strains as the underlying soils, primarily the admix soil liner and the subgrade soil, settle over time. Strain within the lining system was calculated based on the results of the liner foundation settlement calculations (see Section 5.3 for settlement of foundation soil [subgrade] and admix liner). The strain calculation assumed that all vertical settlement was translated into strain along the liner rather than just the vector component parallel to the liner. This is a conservative assumption that establishes an upper bound for liner strain.

The maximum liner strain was estimated to be less than 0.6 percent, based on a maximum estimate of 2.7 feet of settlement at the base of the lining system. See Appendix C.5.b for supporting calculations.

As shown the technical specification (Section 02661, Table 1), the elongation at yield for the geomembrane that will be used in the liner system is at least 12 percent. Based on studies of effect of differential settlement on GCLs (LaGatta et al., 1997), the limiting strain was defined as the strain in which an increase in hydraulic conductivity of the GCL was observed, which was taken as 5 percent.

Therefore, the maximum anticipated strains are well below the yield or limiting tensile strain for the barrier components of the lining system (geomembrane and GCL). Settlement-induced strain from foundation and admix soil settlement under maximum landfill content pressure will have no adverse impact on lining system function.

5.5.3 Anchor Trench Pullout Resistance

During construction, the geomembrane could experience pullout forces caused by thermal expansion/contraction or wind uplift. However, tension from thermal expansion and contraction is expected to be small (see Section 5.5.1), and the geosynthetics installer can use sand bags or other approved method to control wind uplift during installation.

After construction and placement of operation layer, the pullout forces on the geomembrane are expected to be negligible, as there is no tension force on the liner. As indicated in the veneer (side slope) stability analyses (see Section 5.1.1), the lining system interface strength exceeds the slope angle on the 3H:1V side slope. Thus, the pullout resistance requirements for the anchor trench are to support the self-weight of the geomembrane and other lining system components. Analyses for liner self-weight support requirements determined that the frictional resistance between geosynthetics exceeds the liner self-weight. Thus, no additional pullout resistance is needed at the anchor trench to support lining system self-weight.

Supporting calculations for the anchor trench design, as shown on Drawing H-2-830838, Detail 3, are included in Appendix C.5.c. Based on the calculations for the configuration shown in the drawing, a pullout resistance ranging from 1840 pound/foot (lb/ft) to 2440 lb/ft is estimated (depending on actual mobilized interface shear strength). The required minimum tensile yield strength for 60-mil HDPE geomembrane in the technical specifications (see Section 02661) is 1440 lb/ft (120 lb/in), which results in the estimated pullout resistance exceeding the geomembrane tensile yield strength. This situation is due primarily to the configuration of the shine berm, which helps to anchor the system. While it is generally not desired for the pullout resistance to exceed the yield strength, this is not expected to be a problem at the IDF, since, as discussed above, the potential causes for geomembrane tension have been addressed and there is not a scenario for mobilizing tensile or pullout forces on the lining system.

5.5.4 Puncture Resistance

The primary geomembrane in the IDF will be overlain by the LCRS. For the side slope lining system, the LCRS consists of a CDN (see Detail 2 on Drawing H-2-830838) that provides protection for the primary geomembrane from the overlying operations layer. A separate discussion of the CDN geotextile puncture resistance is provided in Section 5.7.2. For the bottom lining (floor) system, the LCRS consists of drain gravel overlying the geomembrane (see Detail 1 on Drawing H-2-830838). A geotextile cushion will be required between the drainage gravel and the geomembrane to prevent the gravel from puncturing the geomembrane. An analysis was performed to determine the weight of the geotextile fabric required to prevent geomembrane puncture either from operating equipment loads or from the combined static weight of the waste and final cover.

Koerner (1998) developed a method for estimating required geotextile thickness that considers the size and shape of the rock, as well as other factors that could decrease the long-term strength of the geomembrane. The equation used to determine puncture resistance is based on the mass per unit area of the geotextile and the protrusion height of the puncturing material.

Operating loads were estimated based on a melter transport trailer operating directly on the surface of the first operations layer. Static loads were estimated for the post-closure condition by using the weight of four layers of ILAW packages with cover soil and a 15-foot-thick closure cover, with a 2 percent grade to the center of the landfill. The static load was more than two times greater than the operating load, and therefore was used as the basis for the puncture analysis. Detail calculations for geomembrane puncture resistance and corresponding cushion geotextile requirements are included in Appendix C.5.d.

The proposed design specifies that the LCRS drainage gravel will have a gradation corresponding to WSDOT Standard Specification 9-03.12(4). This gradation has a maximum stone size of 1 inch. From the curves shown in the detailed calculations, the FS for a 12 oz/yd^2 geotextile loaded by 1-inch angular rock is 4.5. For subrounded rock or gravel, which is more representative of the specified drain gravel, the FS increases to 8.9. The specified cushion geotextile (see technical specifications, Section 02371) has a nominal weight of 12 oz/sq yd, and therefore should be adequate to prevent geomembrane puncture. Koerner (1998) recommends a FS greater than 3.0 for the condition of packed stones on a geomembrane, such as would be the case for drain gravel over the geomembrane at the IDF.

5.5.5 Operational/Equipment Loading

The effects of loading on the GCL from construction and operational equipment and activities was examined. The maximum loads from the landfill waste itself were found to produce the highest loading on the geomembrane and the CDN; these materials were selected based on this maximum loading, as discussed in the previous sections.

The cases for construction equipment loading and operational loading on the GCL were examined, including the extreme loading case of the crane placing the heaviest waste loads at its maximum reach, a situation which produces very high pad loads. The expected loads were compared to the calculated allowable GCL bearing capacity to determine if the loads would have an effect on the GCL. The allowable GCL bearing capacity was determined from classical geotechnical theory and based on manufacturer's strength data.

The results of the analyses are presented in detail in Appendix C.5.e. For the construction loading, the analyses show that the specification requirements that limit construction loading are adequate to protect the GCL, based on the standard construction equipment anticipated to be used at the IDF and as examined in the calculations.

For the operational loading cases examined, the critical condition is the crane operating under an extreme condition. The minimum dunnage requirements for the crane pads is 60 square feet, or if square, a 7.7-foot by 7.7-foot dunnage pad. Lower loads will require less dunnage and can be calculated as detailed in Appendix C.5.e. As discussed in the appendix, dunnage requirements calculated in this way are appropriate as long as the lining system is functioning as intended (i.e., no moisture in the LDS). If moisture enters the LDS and the GCL becomes hydrated, the dunnage requirements will be increased by a factor of approximately 2.5.

It should also be noted that the primary purpose of the GCL in the IDF is not as a required lining system component (such as the geomembrane or the admix liner), but to "deflect" leachate from defects or pinholes in the primary geomembrane over the bottom area and longer-term storage areas (such as leachate sump trough), where the leachate head potential is greatest. The primary purpose of the primary GCL is to reduce the actual leakage rate into the LDS in the event of leak in the primary geomembrane. Given these considerations, the GCL should perform as intended under anticipated equipment and operational loading.

As the operations plans for the landfill are developed, loading values can be compared to the results shown in Appendix C.5.e to determine if the loads will affect the GCL.

5.6 LINER SYSTEMS/LEACHATE COMPATIBILITY

The purpose of this analysis is to demonstrate that the liner materials proposed for the IDF landfill are chemically compatible with the leachate. Certain materials deteriorate over time when exposed to chemicals that may be contained in hazardous leachate. It is important to anticipate the type and quality of the leachate that the landfill will generate and select compatible liner materials. Data collected from other similar low-level radioactive mixed waste and hazardous waste sites were used in conjunction with the anticipated IDF leachate concentrations to evaluate the allowable concentration of leachate constituents that could be in contact with the IDF landfill liner components.

5.6.1 Lining System Description

Detailed discussion of the lining system design elements is provided in Section 6. A summary is provided in this section to facilitate discussion with respect to the chemical and radiation resistance of the lining system components.

Drawing H-2-830838 (Detail 1) shows the bottom liner section consisting of the following components, from top to bottom:

- A 3-foot-thick operations layer
- A separation geotextile (polypropylene)
- A 1-foot-thick leachate gravel layer
- A minimum 12 oz/square yard cushion geotextile (polypropylene)
- A 60-mil (nominal thickness—see Section 6.3.2.1) textured primary HDPE geomembrane
- An internally-reinforced GCL

- A CDN drainage layer for primary leak detection/collection
- A 60-mil textured secondary HDPE geomembrane
- A 3-foot-thick low-hydraulic conductivity compacted admix (soil-bentonite) liner

For the bottom lining system, both the primary and secondary liners are a composite (geomembrane over admix liner or GCL) system. The addition of a GCL in the primary liner layer provides an extra measure of protection, exceeding the requirements of WAC 173-303-665(2)(h)(i), which stipulates a single geomembrane for the primary liner and composite for the secondary only. This will provide an extra measure of protection on the bottom flatter slopes of the IDF, where higher leachate head levels are more likely.

Drawing H-2-830838 (Detail 2) shows the side slope liner section consisting of the following components, from top to bottom:

- A 3-foot-thick operations layer
- A CDN drainage layer for primary leachate collection
- A 60-mil textured primary HDPE geomembrane
- A CDN drainage layer for primary leak detection/collection
- A 60-mil textured secondary HDPE geomembrane
- A 3-ft-thick low-hydraulic conductivity admix liner

The side slope lining system is a single geomembrane liner over a composite liner, meeting the requirements of WAC 173-303-665(2)(h)(i). The 3H:1V side slopes for the IDF will result in little or no leachate head build-up on the side slope lining system, thus eliminating the need for a lining system design that exceeds the WAC requirements.

In general, the liner system consists of two types of materials, geosynthetics and soil/bentonite mixtures (admix). The geomembranes, geotextiles, and CDN are manufactured from polymeric materials, such as HDPE, and polypropylene, made from synthetic polymers. The GCL consists of a bentonite layer sandwiched between two polypropylene geotextiles to assist in placement and construction. The admix liner is comprised mainly of silt to clay-sized particles, mixed with a silty sand base soil.

5.6.2 Leachate Characterization Assumptions

Several assumptions were made regarding the composition of the leachate concentrations and the applicability of previously conducted studies for this evaluation. Specifically, the studies considered directly applicable to this evaluation were:

- Geosynthetic and Soil Liner/Leachate Compatibility Studies for the W-025 Radioactive Mixed Waste Landfill in Hanford 200 West (Golder Associates, 1991a and 1991b; TRI, 1995; and WHC, 1995)
- Liner/Leachate Compatibility Study for the U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Disposal Facility (ICDF) (DOE-ID, 2002).

Using these studies is considered appropriate for the following reasons:

- The leachate for the IDF is expected to have similar or lower concentrations of radionuclides than that used in the W025 facility study (since similar waste streams [other than ILAW] may be accepted).

- The leachate chemistry may be of similar composition to the W025 facility study (since similar waste streams [other than ILAW] may be accepted).

- Soils used in the W025 facility admix design are similar to those that will be used in the IDF admix design and will therefore be compatible.

- Similar technical specifications for the geosynthetics and admix liner used in the W025 facility design will be used in the IDF landfill design.

- A similar technical specification for a GCL used in the ICDF facility will be used in the IDF liner design.

5.6.2.1 Synthetic Leachate Concentrations for W-025 Landfill

The leachate generated for the W025 evaluation reflects both the waste materials and the stabilization agents used during waste preparation. Because the landfill will comply with waste acceptance criteria for WAC dangerous waste and RCRA facilities (as does the IDF), organic materials are not expected to be present in the waste after processing. The proposed geosynthetic materials are susceptible to damage from certain organic compounds but generally are not susceptible to damage from inorganic compounds, even with extreme pH values. As a result, the lack of organic materials results in a relatively benign leachate.

The source leachate generated for the W025 studies, was primarily based on the waste treatment and packaging approaches for W025. An aqueous solution of inorganic, with some organic compounds for conservative evaluation, was generated, resulting in a viscous, slurry-like mixture. This mixture was placed in a leaching column, and deionized water was introduced to simulate the effects of leachate generation. Although no organic components were anticipated in the waste, small quantities of benzene, methanol, and light machine oil were included to simulate the presence of organic compounds in the waste material.

The source leachate generated through the leachate column process was chemically analyzed with the following results:

- Concentrations of organics benzene and machine oil were below detection limits. Concentrations of methanol were detected, but at concentrations not considered aggressive for polyester or HDPE.

- Metals added to the waste were below the detection limits in the source leachate.

- Primary constituents of the source leachate were sodium cations and common inorganic anions, with a pH of 9.2.

- Based on these results, a synthetic leachate was generated for testing purposes. The source leachate formula resulted in a solution with total inorganics and dissolved salts of approximately 204,000 mg/L and pH of 9.2 using NaOH or HNO_3, as required.

5.6.2.2 Simulated Irradiation Exposure for W-025 Landfill

Samples used to evaluate the effects of radiation were subjected to a 50,000-rad total dose of gamma radiation. This dose is expected to exceed the maximum level of radiation experienced by geosynthetic materials in the landfill under unfavorable conditions. Use of a total dose, rather than radiation type, is considered the primary factor causing damage to polymeric materials and is considered to adequately simulate actual IDF leachate conditions. Samples and leachate were irradiated together so that any synergistic effects would be seen. The following samples were included in the irradiation testing:

- Geomembrane
- Geotextile
- Geonet
- Admix (soil/bentonite mixture)

The synthetic leachate and radiation exposure developed from the W-025 studies were used as the basis of evaluation for the IDF lining system materials. Table 5-2 provides a comparison of the leachate concentrations for the W-025 project with other studies for which the U.S. Environmental Protection Agency (EPA) Test Method 9090 were performed on the lining system.

The ICDF project did not include EPA 9090 tests, however, a model for estimating leachate concentration based on the waste acceptance criteria for the project was developed. The maximum leachate concentrations and radiation exposure developed for the ICDF (DOE-ID, 2002) based on the anticipated waste design inventory were as follows:

- Organics–70 mg/l
- Inorganics–18,400 mg/l
- Radiation Exposure–12,000 rads

Table 5-2: EPA Test Method 9090 Compatibility Studies Comparison

Compatibility Study[a]	Type of Material Tested	General Composition of Leachate	9090[b] Test Concentrations or Radiation Exposure that Demonstrated Compatibility in Each Study
Hanford Liquid Effluent Retention Facility (LERF)	60-mil smooth HDPE from four manufacturers	Organics	16.25 mg/L
Hanford W-025 Landfill	**60-mil smooth HDPE**	**Inorganics**	**204,210 mg/L**
		Organic Leachate and Radiation Exposure	**50,000 rads**
		pH	**9.2**
Hanford Grout Facility	60-mil smooth HDPE	Inorganics	368,336 mg/L
		Organic Leachate and Radiation Exposure	37,000,000 rads
		pH	>14
Kettleman Hills Landfills	60-mil smooth HDPE	Organics	93,040 mg/L
		Inorganics	250,000 mg/L
		pH	>12

a. Detailed compatibility test information is provided in *Evaluation of Liner/Leachate Chemical Compatibility for the Environmental Restoration Disposal Facility report* (USACE, 1995).
b. EPA Test Method 9090 "Compatibility Test for Wastes and Membrane Liners" (EPA, 1992c).

A review of the studies presented in Table 5-2 leads to the conclusion that the inorganic concentration developed for the W025 is somewhat conservative as it significantly higher than inorganic concentrations developed for the ICDF facilities. Other than the W-025 landfill, the ICDF is estimated to be most similar to the waste type to be received at the IDF of the studies included in Table 5-2. Nonetheless, the liner/leachate compatibility study for the IDF is based on the W025 synthetic leachate. Further analysis of the applicability of these leachate concentrations is recommended, if the conservative nature of this synthetic leachate requires costly revisions to the lining system to demonstrate compatibility.

5.6.3 Chemical and Radiation Resistance

Leachate will be generated from precipitation events and from water added to the waste for dust control and compaction purposes during operations. In reality, as the landfill nears the end of its operational life, concentrations of contaminants will decrease with time as the leachable waste mass is reduced. During the post-closure period, a robust landfill cover will significantly reduce infiltration, and the corresponding volume of leachate. Soluble contaminants leached from the waste will come in contact with the landfill bottom liner system during the operation period (approximately 10 years for each of the four planned phases) and minimum post closure period (30 years). The geosynthetics and admix lining system components may be in contact with soluble contaminants as long as contaminants are present in the landfill.

The expected chemical make up of the leachate for the IDF landfill was determined based on previously conducted compatibility studies (as discussed above) applicable to the same waste stream (the W025 studies), summarized as follows.

5.6.3.1 Geomembrane

HDPE geomembranes can deteriorate from contact with certain leachates, resulting in a decrease of elongation at failure, an increase in modulus of elasticity, a decrease in the stress at failure, and a loss of ductility.

Studies performed on polymer materials like HDPE show that their properties begin to change after absorbing ionizing radiation between 1,000,000 to 10,000,000 rads (Koerner et al., 1990). The HDPE geomembrane lining the bottom of the landfill will absorb ionizing radiation energy from the leachate generated in the landfill. Energy will be absorbed during the operational life of the landfill, as long as there are liquids with ionizing radionuclides in contact with the geomembranes.

Relevant compatibility studies on HDPE geomembranes have been performed for the W-025 Landfill (Golder, 1991a; TRI, 1995; WHC, 1995). The results of these studies indicate that a HDPE geomembrane will function well as a liner beneath the landfill waste. EPA Method 9090 tests performed on HDPE geomembrane for the W-025 landfill, using the synthetic leachate solution (assumed representative of IDF leachate concentrations) resulted in no evidence of geomembrane deterioration. A comparison between the anticipated IDF landfill leachate (W-025 Landfill) and that used in compatibility tests for other facilities is summarized in Table 5-2.

Geomembrane samples tested for the W-025 facility did not produce measurable changes in the HDPE liner properties when irradiated for 120 days with a total dose of 50,000 rads. HDPE geomembranes are manufactured with additives, such as carbon black and antioxidants, to improve ductility and durability. The literature also indicates that these additives allow higher doses than standard HDPE material without additives (Kircher and Bowman, 1964). The literature indicates that thin films (i.e., 0.002 inches) of different types of HDPE material alone can become brittle when irradiated at doses between 4,400,000 and 78,000,000 rads. Studies performed using polymer materials, with carbon black and antioxidant additives, show that properties typically begin to change at a total radiation dose of between 1,000,000 and 10,000,000 rads (Koerner et al., 1990).

The manufacturers of the geosynthetic products proposed for the IDF landfill have published maximum allowable concentrations of various chemical compounds that can contact the HDPE geomembrane without adversely affecting its performance. The most recent recommended maximum concentrations of chemicals were obtained from the manufacturers of HDPE geomembrane (meeting the requirements for the IDF technical specifications). A list of the manufacturers' maximum allowable concentrations for specific leachate constituents for HDPE geomembrane and the GCL materials is shown on Table 5-3.

5.6.3.2 Geosynthetic Clay Liner (GCL)

The GCL underlying the geomembrane in the IDF landfill consists of processed sodium bentonite clay, sandwiched between two geotextile fabrics. Sodium bentonite is an ore comprised mainly of the montmorillonite clay mineral with broad, flat, negatively charged platelets that attract water which hydrates the bentonite. The swelling provides the ability to seal around penetrations, giving the GCL its self-healing properties. A GCL product with Volclay-type sodium bentonite (manufactured by CETCO) is specified for installation at the landfill.

The compatibility of GCL materials is usually demonstrated by permeating the material with leachate and then determining its hydraulic conductivity. Typically, solutions with high concentrations of contaminants or pure products are allowed to permeate a sample under confining pressure and the saturated hydraulic conductivity of the material is determined using ASTM methods such as ASTM D5084. A significant increase in saturated hydraulic conductivity (approximately one order of magnitude) for a sample permeated with leachate, compared with a sample permeated with water, would be an indicator of incompatibility.

Based on review of the published studies (Ruhl and Daniel, 1997; Shackelford, et al., 2000; and EPA, 1995), GCLs perform well unless exposed to high concentrations of divalent cations, very acidic or basic solutions, or solutions with a low dielectric constant (such as gasoline). The leachate expected at the IDF will have a pH of 9.2, which is a mid-range pH. The studies further demonstrate that, when confined under a higher normal load (greater than 2000 psf) or if water is the first wetting liquid (Daniel et al., 1997), GCLs will perform well when exposed to high divalent cation concentrations. The GCL for the IDF lining system is expected to confine under normal loads in excess of 2000 psf as soon as the first lift or waste is placed.

No studies were identified that considered the long-term effects of radiation on the physical properties of GCL materials. Since long-term studies cannot be conducted, conservative radiation limitations have been employed. Low-hydraulic conductivity soils have been used at multiple DOE facilities containing radioactive waste. The only known potential adverse reaction that can occur with a GCL is high heat that could dry out the materials. The amount of radioactivity is expected to be low in the IDF landfill waste and will not generate a significant amount of heat that can desiccate the admix liner. Also, it is assumed that the ILAW packages will be cooled to ambient temperatures prior to placement with the cell. It should be noted that the operations layer and drain gravel will provide a 3-foot buffer on the side slope and a 4-foot buffer between the liner system and waste for additional thermal protection, if needed.

Sodium bentonite is the primary clay mineral in a GCL that produces the low hydraulic conductivity and high swell potential. Exposure of sodium bentonite to liquids containing concentrated salts (such as brines), or divalent cation concentrations (such as Ca++ and Mg++), reduces the swelling potential and increases its hydraulic conductivity. Concentrated organic solutions (such as hydrocarbons) and strong acids and bases can break down the soil, which also increases hydraulic conductivity. The physical mechanism that causes these changes is a reduction of the thickness, and related absorption capacity, of the diffuse double layer of water molecules surrounding the clay minerals. This results in an effective decrease in the volume of the clay, since the water molecules are not attracted to the clay particles.

The GCL manufacturer allows the use of GCL with few restrictions on maximum chemical concentrations. Leachate concentrations for the IDF landfill (based on synthetic leachate from W025) have relatively high inorganics and dissolved salts. The W025 dissolved salt concentrations are above the manufacturers recommended concentration of 35,000 mg/L (see Table 5-3) (CETCO, 2001). As a point of reference, this concentration of dissolved salts is typical of seawater (USGS, 1989). However, the dissolved salt concentrations in the IDF leachate have been characterized as primarily sodium, and the synthetic leachate was comprised of entirely sodium salts, not the divalent cations such as Ca++ and Mg++, as assumed by the manufacturers. As such, the impact on GCL hydraulic conductivity should be less as compared to divalent cation solutions. Additionally, any effects of leachate degradation on the GCL would be minimized by hydration of the GCLs' sodium bentonite with relatively "fresh" water, allowing the GCL to swell initially and decrease hydraulic conductivity.

The rationale for use of the GCL in the IDF landfill primary liner is to "deflect" leachate from defects or pinholes in the geomembrane over the bottom area and longer-term storage areas (such as the leachate sump trough), where leachate head potential is greatest. The main purpose of the primary GCL is to reduce the actual leakage rate into the LDS in the event of leak in the primary geomembrane (see Section 5.10 and Appendix C.10). The GCL is expected to contact leachate only in the event of a leak in the primary geomembrane. These leachate collection and storage areas are subject to flushing throughout the active life of the landfill due to phased development and fill sequence, resulting in a more dilute leachate in leakage areas prior to attaining maximum leachate concentrations. Based on these considerations, the GCL and landfill liner system approach should perform as intended under the anticipated conditions.

5.6.3.3 Admix Liner

The admix layer consists of onsite silty sand mixed with processed bentonite amendment, similar to that used in the construction of GCLs. The swelling of sodium bentonite provides the ability to seal around soil particles, giving the admix a low hydraulic conductivity and self-healing properties. The compatibility of the admix layer with anticipated irradiation and leachate concentrations were evaluated previously as part of the W025 landfill design (Golder Associates, 1991b). The following summarizes the results of the compatibility testing for the admix layer that are directly applicable to the IDF landfill admix liner, since similar materials will be used in construction. More detailed discussion of the IDF admix liner design is provided in Section 5.4.

In the W025 study, samples of the admix were irradiated, similar to that conducted for the geomembrane layer, as discussed previously. Differences between irradiated and non-irradiated samples were not considered significant based on the results of testing.

The initial W025 admix design contained approximately 8 percent bentonite clay. Testing indicated an acceptable hydraulic conductivity of this admix after hydration in fresh water. However, when hydrated in leachate, some hydraulic conductivity test values were twice the allowable limit and, therefore, this admix formulation was not considered acceptable. This is the same leachate chemistry assumed for the IDF landfill. It should be noted that there are two factors not considered in the W025 compatibility study (Golder Associates, 1991b) that would mitigate the impact of the synthetic leachate on the 8 percent admix samples, as listed below:

- **Effective stress for samples**–hydraulic conductivity tests were performed with effective stresses of 5-10 psi across sample (equivalent to less than one full lift of ILAW packages). It is well documented that higher effective stresses will lower hydraulic conductivity and mitigate the effects of shrinking/cracking in clay under attack from chemicals. In reality, by the time any leachate contacts the lining system, there will be a substantial stress load on the liner that will mitigate the impacts of chemicals in leachate on the admix liner.

- **First wetting liquid**–W025 tests were performed using both site water and synthetic leachate as the initial wetting fluid. It is well documented that if a clay soil is "attacked" by inorganics prior to saturation, the increase in hydraulic conductivity will be more dramatic than if water is first permeant. This was confirmed by W025 testing–there was an order of magnitude difference between samples with water as first wetting liquid as opposed to leachate. It is reasonable to expect something closer to water than concentrated leachate will be the first wetting liquid for the IDF admix liner.

Due to the results in the W025 testing showing greater than acceptable hydraulic conductivity in the admix when exposed to the W025 synthetic leachate, the bentonite percentage was increased from 8 to 12 percent. An admix containing 12 percent bentonite clay was permeated with synthetic leachate and tested with a resulting hydraulic conductivity that was 3 to 10 times lower than the maximum allowable limit (10^{-7} cm/sec). This admix formulation was considered acceptable with respect to W025 leachate compatibility and is applicable to the IDF. Thus, the technical specifications (see Section 02666) require a nominal 12 percent (range from 11 to 14 percent is acceptable) bentonite by weight for the admix liner. Consideration should be given to lowering the bentonite percentage upon further characterization of the IDF leachate and applicability of the mitigating factors discussed above.

5.6.3.4 Other Materials

Other materials for which compatibility needs to be addressed are the CDN and geotextiles (cushion, separation, and bonded to geonet of CDN). While these materials do not serve a barrier function, they provide either for removal of leachate or protection of the lining system and must continue to function when exposed to leachate.

During the W025 design, the effect of the synthetic leachate on the geonet core of the CDN and the geotextiles was evaluated (Golder Associates, 1991a). The study concluded that a geonet core comprised of HDPE provided adequate chemical and radiation resistance. For geotextiles, the study concluded that geotextiles made of polyester fabric were susceptible to degradation and recommended that geotextile material be limited to a more chemically resistant material such as polypropylene. The technical specifications for the IDF require that geotextiles be made from polypropylene (see Section 02371); thus, the geotextiles used for the IDF should have adequate chemical and radiation resistance.

Table 5-3: Maximum Allowable Concentrations in Leachate by Chemical Category for Geosynthetic Components

Chemical Category	Compatible Concentration for HDPE	Compatible Concentration for GCL	IDF Concentration Dose or Value
Organics	500,000[a] mg/L	500,000[b] mg/L	N/A
Acids and Bases	750,000[a] mg/L	500,000[b] mg/L	0[d] mg/L
Inorganic	500,000[a] mg/L	500,000[b] mg/L	204,000 mg/L[c]
Dissolved Salts	No Limit	35,000[a] mg/L	204,000 mg/L[c]
Strong Oxidizers	1,000 mg/L	No limit	0 [d] mg/L
Radionuclides	1,000,000[b] rads	No limit	50,000 rads[c]
PH	0.5 - 13.0[a]	0.5 - 13.0	9.2

a. Based on the typical manufacturers' maximum concentration of the list of constituents by the manufacturers.

b. Based on reported literature values.

c. Based on synthetic leachate formula for W-025

d. Strong acids, bases, or oxidizing compounds were not identified in the W-025 compatibility studies.

5.7 DRAINAGE LAYER

The drainage layer for the LCRS consists of three components: the separation geotextile, the CDN, and the drainage gravel. Analyses for the drainage layer required evaluation of these components.

5.7.1 Geotextile Analyses (Separation)

Analyses were preformed to verify that a separation geotextile between the operations layer and leachate collection drain gravel is required by evaluating natural graded filter criteria for these materials. Results indicated that natural filter criteria could not be achieved, thus a separation geotextile is required between the operations layer and drain gravel. Supporting natural filter calculations are included in Appendix C.6.a.

Analyses were conducted to determine the proper apparent opening size (AOS) and permittivity of the separation geotextile. Required AOS and permittivity were determined based on filter, fines retention, and clogging potential criteria. Results of these analyses were used to develop the technical specifications for the separation geotextile (see Section 02371). Supporting geotextile filter calculations are also included in Appendix C.6.A.

5.7.2 CDN Selection

The CDN selection was based on analysis of two design issues, CDN geotextile puncture resistance and CDN required transmissivity.

5.7.2.1 CDN Geotextile Puncture Resistance

The LCRS CDN layer at the IDF will be overlain by the operations layer on the 3H:1V side slope. The operations layer is allowed to contain a particle size up to 2 inches in dimension. An analysis was performed to determine if the geotextile bonded to geonet (to form the CDN) would be punctured by particles/rocks of this size.

The method developed by Koerner (1998) was used to calculate the puncture resistance. Koerner's method considers the size and shape of the rock, as well as other factors that could decrease the long-term strength of the geotextile. The two loading conditions examined were initial placement of the operations layer and the final depth of waste and closure cover. The geomembrane puncture resistance analysis (see Section 5.5.4) provides the details for the load analysis for these conditions. Detailed calculations for CDN geotextile puncture resistance and corresponding cushion geotextile requirements are included in Appendix C.6.b1.

Results of the analyses indicate that the required puncture resistance is 11.2 lbs. The minimum specified value for Type 1 geotextile (see technical specifications, Section 02371) is 65 lbs. Applying a partial safety factor of 2 gives a minimum resistance of 32.5 lbs. Therefore, the proposed geotextile bonded to the geonet of the CDN will resist puncture with a global safety factor of 2.9; it is adequate for resistance to puncture from the overlying operations layer under the pressure of maximum landfill contents pressure. Koerner (1998) recommends a minimum global safety factor of 2.0.

It should be noted that the results of this analysis are considered conservative because the analytical method assumes only a uniform particle size and does not take the surrounding soil matrix into consideration. This would effectively reduce the particle size by a considerable degree.

5.7.2.2 CDN Required Transmissivity

An additional selection criteria for the CDN is the required transmissivity (or flow rate) under design loading conditions. For the IDF there are two cases that require analysis:

- **LDS CDN on bottom and side slope**–For this case, the critical condition is to ensure that the transmissivity as required by WAC and EPA regulations (3 x 10^{-5} m^2/sec) under the maximum load from the landfill contents can be achieved.
- **LCRS CDN on side slope only**–There are actually two loading conditions for the LCRS CDN on the side slope. One is the open slope condition with operations layer only over the CDN, which is a low normal load (1,000 psf) condition. The second is in the filled condition, which is a high normal load (15,000 psf) condition. Based on the results of leachate production analyses using

the Hydrologic Evaluation of Landfill Performance (HELP) model (see Section 5.8), the required transmissivity for the LCRS CDN is 6.5 x 10^{-5} m^2/sec for the open slope condition and 1 x 10^{-5} m^2/sec for the filled condition.

For each case, the approach was to compare the required transmissivity to typical manufacturer's data with test conditions (i.e., normal load and material boundary), similar to the design conditions. The allowable transmissivity (φ) was determined using guidance provided by GRI standard GC-8 (2001), *Determination of the Allowable Flow Rate of a Drainage Geocomposite*. The GRI-GC8 standard uses the following equation:

$\varphi_{allow} = \varphi_{100\ hr\ test}$ /Reduction Factors for intrusion, creep, chemical clogging and biological clogging

The FS for design was then determined as follows:

$FS = \varphi_{allow}/\varphi_{required}$

Transmissivity data for the 100-hour test data was obtained from the manufacturer for both 200-mil and 250-mil thickness CDN for normal loads of both 1,000 psf and 15,000 psf. Test data was provided for a number of boundary conditions including flow tests between a geomembrane and a soil, as would be the case for the LCRS or LDS CDN. Test data used as the basis for the analyses are included with the calculations presented in Appendix C.6.b2.

Based on the analyses, a higher flow, thicker (250-mil minimum) CDN is required, due to the reduction of flow under the high normal loads in the final filling configuration. The technical specifications (see Section 02373) provide the required index values for the geonet core of the CDN as well as the CDN itself (with geotextile bonded to both sides of the geonet), based on the results of this analysis. The transmissivity requirements in the technical specifications are index values and not in-service condition values, as determined in this analysis. These index values are representative of testing that manufacturers typically perform in production and are correlated to design conditions using the approach outlined in GRI GC-8.

5.7.3 Drainage Gravel Selection

Section 02315 (Fill and Backfill) in the technical specifications requires that drain gravel meets the requirements of WSDOT 9-03.12(4) for gradation. The technical specifications also require a performance specification for a hydraulic conductivity greater or equal to 10^{-1} cm/sec.

Hydraulic conductivity of the specified drain gravel was estimated using two different empirical relationships. The most relevant of the two estimates a minimum hydraulic conductivity of 1 cm/sec, based on the specified gradation curve for WSDOT Gravel Backfill for Drains (9-03.12[4]). Supporting calculations are included in Appendix C.6.c.

The minimum estimated hydraulic conductivity for the drain gravel exceeds the required (by WAC and EPA regulations) hydraulic conductivity of 10^{-2} cm/sec by a factor or 100 to 1,000, and the performance specification hydraulic conductivity of 10^{-1} cm/sec by a factor of 10 to 100. This exceedance makes an allowance for two items: (1) it allows for the uncertainty in the empirical formulas used to predict hydraulic conductivity, and (2) it also allows for the potential long-term reduction in hydraulic conductivity in the drain gravel as fines from waste filling and the operations layer migrate into the gravel over time.

As part of Construction QA testing it is recommended that samples of imported drain gravel be tested for conformance with the gradation and hydraulic conductivity requirements in the technical specifications.

5.8 LEACHATE PRODUCTION

5.8.1 Leachate Production Analyses

Estimates of the amount of leachate produced during the development and operation of the IDF were needed to design the components of the leachate collection and conveyance system described in Section 5.9, and to provide information necessary when evaluating slope stability of the side slope and bottom liner systems. Leachate is produced when precipitation falls within the lined area and infiltrates vertically through the waste and/or bottom liner system. The amount of infiltration estimated to occur depends on the hydrologic processes and the relative fraction of precipitation that results as leachate and is collected by the leachate collection system.

The water balance components of the hydrologic process were estimated using EPA's *Hydrologic Evaluation of Landfill Performance (HELP) Model* (Schroeder et. al., 1997), a well known standard for water balance modeling. The HELP model has been widely used for evaluating hydrologic conditions and is the standard model used for providing information necessary for the design of landfill systems. Estimates of the water balance components of the hydrologic cycle provided by HELP include precipitation, evapotranspiration, surface water runoff, vertical percolation, soil moisture storage, and lateral drainage in soil layers.

The HELP model requires input of weather data, representing the conditions at the landfill location, soils data representing the various layers of cover soils, waste materials, and soils underlying the waste layers, and other design data used by the model for water balance calculations. A detailed description of the model and modeling inputs are included in Appendix C.7.

The development of the IDF from Phase I through Phase IV was considered to determine the maximum flow condition expected during development and operation of the landfill. That is, various combinations of open and interim closed phases were considered and the combination calculated to produce the maximum amount of leachate was chosen for analysis. The chosen combination was Phase I through III under interim closure condition and Phase IV in the open condition with little or no waste present. The flows from this condition were used to size the LCRS collection piping and pump systems.

Water balance components were taken directly from model output and a spreadsheet was used to calculate the volumes of leachate by multiplying the HELP output parameter by the area of the type of system modeled. For example, the lateral drainage estimated by the HELP model for the uncovered side slope condition in Phase IV development was multiplied by the total side slope area to determine the total volume of leachate from that area. A spreadsheet summarizing the estimated leachate flows is included in Appendix C.7.

The following modeling results were used for various aspects of design of the IDF systems:

LCRS collection system–Modeling results for the peak day event were used to size the leachate collection system piping that conveys flow to the LCRS systems. The peak day event, as predicted by HELP and referenced herein, was a 1.6-inch precipitation event. This event is approximately 25 percent higher than the 25 year, 24 hour peak day storm event of 1.28 inches (Appendix C.9), required by regulations to be used when complying with the maximum 12 inches of head over the liner (WAC 173-303-665, see Section 2). The spacing of the LCRS perforated collection piping and the properties of the drain gravel material that convey lateral drainage flows above the bottom liner geomembrane to the collection piping and LCRS sump area were checked to insure the maximum head buildup above the sump area of the liner system did not exceed the maximum allowed according to regulatory requirements, as outlined in Section 2.

LCRS pump and forcemain systems–Modeling results for the peak day event were used to size the LCRS high flow pump system that conveys flow to the leachate storage tanks and truck loadout facilities.

Average monthly flow rates plus one standard deviation (resulting in a conservatively-high expected flow rate) were used to design the LCRS low flow pump system for pumping from the IDF during average monthly conditions.

Leachate Collection Storage–Volumes for the peak day event and assumptions for the operational rate of removal of leachate from the tanks were used to size the storage tanks. Storage tank sizing is described in Section 5.9.2.2.

Liner system material properties and stability analyses–The lateral drainage layers of the side slope and bottom liner systems were checked to insure the transmissivity of the layers was sufficient to convey lateral flows and maintain less than the maximum head buildup over the liner system. The seepage height above the liner was used when checking the liner system for veneer stability.

5.9 LEACHATE COLLECTION SYSTEM

5.9.1 Earth Loading Analyses

5.9.1.1 Leachate System Loading Analyses for Piping within Phase I Liner Limits

Loading over the leachate system piping include all layers of soil materials, wastes, and anticipated traffic loading. The maximum loading occurs over the piping in the LCRS and LDS sump area, because of its low elevation and the height of material–both waste and soil layers–overlying the sumps. Loading calculations from the geosynthetic liner puncture resistance calculations described in Section 5.5.4 were modified to represent the maximum loading in the LCRS/LDS sump area. Other pipes in the Phase I area, including piping outside the sump and the side slope riser piping, will be subjected to less than the maximum loading. The maximum loading is listed in Appendix C.8.a, along with the calculations for pipe sizing required to withstand this anticipated pipe loading.

Pipe wall thickness was selected based on the maximum loading anticipated in the sump area such that the pipe will not fail due to excessive deflection, wall buckling, or wall crushing. All other piping in Phase I outside of the sump area was chosen with the same standard dimension ratio (SDR) to withstand the maximum load. Standard analysis methods, as recommended by the manufacturer of HDPE pipe made from PE3408 type resin, were used to evaluate pipe strength under loading. These standard methods are based on flexible pipe design practice as applied to HDPE piping. The manufacturer's recommended design analysis techniques are based on standard analysis techniques, including the Iowa formula (*Waste Containment Systems, Waste Stabilization, and Landfills Design and Evaluation*, Sharma and Lewis, 1994), with conservative factors of safety. The potential loss of strength due to the perforations in the perforated collection piping was assumed non-significant, based on actual test results of perforated pipe under similar load rates. The pipe material assumed is High Density Polyethylene PE3408 pipe with a cell classification of 345434C or better. The flexural modulus and material strength of the pipe was per manufacturer's published literature, based on this classification of pipe.

5.9.1.2 Leachate System Loading Analyses for Piping Outside of Phase I Liner Limits

Piping outside the Phase I liner area includes all underground piping between the crest pad building, combined sump, leachate transfer building, storage tank, and tanker truck load out facility (see Drawing H-2-830846). The civil road layout in these areas is generally configured to allow medium to light duty trucks, such as would be used for operations and maintenance activities. The leachate tanker truck accesses the concrete truck load pad only, and would not normally pass over any piping. However, the piping outside the Phase I Liner area was designed for H-20 semi-trailer type loading to be conservative. The same SDR pipe that used for the high loading within the Phase I liner limits as described in Section 5.9.1.1 was assumed for all piping exposed to earth and traffic loading outside of the Phase I liner limits. The expected pipe loading for H-20 loading plus earth load was compared to the loading used for designing the piping inside the Phase I liner limits and was found to be much lower. Since the pipe SDR is sufficiently strong for the maximum loading inside the Phase I limits, it will have more than sufficient strength for loading expected outside the Phase I limits. Calculations are included in Appendix C.8.a.

5.9.2 Leachate System Hydraulics Analyses

5.9.2.1 Leachate System Hydraulics Analyses

The leachate collection and conveyance system collects leachate that accumulates as a result of precipitation landing within the footprint of the cells, and it conveys the collected leachate from the cells to a storage tank or tanker truck. Perforated collection piping in the LCRS collects and conveys leachate from the bottom liner system and conveys it to a LCRS sump area in both cells. Lateral flow of leachate from the side slope and bottom liner areas also is conveyed directly to the sump area through a high permeability gravel layer and/or geosynthetic drainage net material. Submersible pumps in the LCRS sump and contained within perforated riser pipes convey leachate to the crest pad building and directly to the leachate storage tank or the tanker truck load facility. Hydraulics analysis was conducted to size the gravity flow piping of the LCRS collection piping and the pump and force main system from the sump area to the storage tank and tanker truck load facility. Sizing and design of leachate collection and conveyance systems were based on ultimate buildout of the IDF through Phase IV. That is, the components installed as part of the Phase I design are sized for the ultimate configuration and flows estimated through Phase IV.

5.9.2.2 LCRS Gravity Flow Analyses

The LCRS perforated collection piping was sized using standard gravity flow analysis techniques. The pipe size (nominal 12-inch diameter) was chosen as double the minimum size required for cleanout of the pipe to insure any accumulation of fines would not significantly restrict the flow in the pipe, even though the drain gravel surrounding the pipe will have minimal fines present and geotextiles are present in the lining system to further restrict the migration of any fines. The maximum flow used for sizing was the maximum from either the HELP predicted maximum day flow rate or the pump flow rate, based on the pump chosen to convey flow out of the cell.

Perforations in the pipe were sized to allow flow rates much higher than the required maximum flow rate out of the cell, with minimal head loss. This assumption was more conservative by virtue of the fact that the main LCRS collection pipe will only collect and convey a portion of the lateral drainage flow from the cell; the drain gravel and CDN will also convey a portion of the flow. Calculations are included in Appendix C.8.b.

5.9.2.3 Leachate System Pumps and Force Mains Analyses

The pump and forcemain systems for conveying leachate out of the cells and into the leachate storage tanks and to the tanker truck load out facility, and the design considerations for each are described below. Calculations are included in Appendix C.8.b.

LCRS pumps and forcemains–The LCRS pumps and forcemains convey leachate out of the cells to storage tanks or the tanker truck load areas. The criteria for pumping capacity is that the maximum head over the sump area of the cell will not be allowed to exceed 12 inches during the peak day event and during normal operations. To meet the requirement for not exceeding the 12-inch criteria for the peak day event, a LCRS high flow pump was sized to handle the expected peak day flow rate, as estimated and described in Section 5.8, Leachate Production. Hydraulic analyses were conducted to size the pump and forcemain piping according to standard practice to convey the maximum flow rate.

A LCRS low flow pump was sized to convey flow out of the cells under normal, monthly operations. The criteria established for the low flow pump was to convey the average monthly flow plus one standard deviation from the cells, assuming the pump could remove that amount of flow with less than continuous operation. The highest value of the average month plus one standard deviation was used for the maximum flow required of the pump. Under lower flow required conditions, the pump would operate near this rate, depending on the system curve head loss characteristics, but would run for a shorter length of time to remove the volume of leachate from the cell.

LDS pump and forcemain–The LDS pump and forcemain conveys flows from leakage through the LCRS sump area, if in the unlikely event any leakage occurs, to the storage tank or tanker truck load out facility. The LDS system is sized to convey the flow equal to the ALR (described in Section 5.11); however, this rate is so small that the pump capacity is much higher than necessary.

Leachate transfer pump to truckload and forcemain–Under normal operations, leachate conveyed out of the IDF will be routed to the leachate storage tank. Periodically the leachate will need to be conveyed to tanker trucks for transport to an offsite water treatment facility. A transfer pump is required to move water from the storage tank to the tanker truck loadout facility. The pump and forcemain were sized to convey approximately 250 gallons per minute (gpm), a rate commensurate with timely loading of the tanker trucks that have capacities equal to approximately 7,000 gallons. At 250 gpm, the tankers can be loaded quickly, depending on the operational requirements for moving leachate and making storage tank capacity available under high precipitation conditions and/or the condition when the storage tanks are at or near capacity. Storage and operations considerations are described in Section 5.9.2.4.

Combined sump pump and forcemain–The combined sump pump and forcemain must convey flow from the sump to the leachate storage tank. The flow criteria for this pump was set at approximately the same flow as the leachate transfer pump. This is based on the worst case scenario of the leachate transfer pump accidentally being left on when the tanker truck is filled, causing the full 250 gpm flow to overflow the truck, collect on the pad, and drain into the combined sump. Under less than maximum flow conditions, the pump would cycle when any leakage from other systems connected to the sump pump reached the level on control setting for the pump. In this case, the pump would cycle quickly to pump the small volume of the inner sump into the storage tank.

Crest pad building sump pump–A small sump pump is provided in the crest pad building to remove minor amounts of water in the sump from sampling activities or piping leaks. The nominal flow rate was chosen as a minimum of four gpm. The pump discharges into the main forcemain line to the storage tank or tanker truck load out facility.

The pump and forcemain piping systems were modeled using standard hydraulic analysis techniques. Actual pump curves for preliminary pump selections were input and the analyses conducted to determine the estimated run condition for the various operational conditions. For example, a pump was chosen for the LCRS high flow pump and forcemain system, and the analysis was run for the conditions of the pump conveying flow to the leachate storage tank and directly to the tanker truck load out facility. Different flow rates and system pressures resulted, based on the differences in the system curve for each flow path versus the pump curve characteristics. Pump cycle times were considered for the flow requirements and total removed volume. The manufacturer's recommendations for cycle times and other operating requirements, where applicable, were checked.

5.9.2.4 Leachate Collection Storage Analyses

The results of the leachate production analysis indicate a total of approximately 269,000 gallons of leachate must be removed from the IDF landfill within 24 hours after a peak storm event. A temporary storage tank for each cell was sized to store leachate generated by the associated cell. The leachate storage tank capacity is dependent on the flow rate of leachate into and out of the tank as well as a factor of safety.

The leachate production analysis indicates the worst case flow rate out of each cell into the associated tank would be 157 gpm (sum of the required flow rates of the high and low flow leachate pumps). The leachate transfer pump for each cell can fill a tanker truck at a maximum of 250 gpm; however, the limiting factor is how often a truck can be filled.

The calculation in Appendix C.8.c presents the method of determining the appropriate storage capacity of each leachate storage tank. The following leachate tanker truck loading activities were assumed:

• Tanker Capacity	7,000 gallons
• Number of tankers per cycle	1
• Hours per cycle (roundtrip)	2.4
• Hours per shift	8
• Shifts per day	1
• Leachate tank level prior to event	2 feet

The calculation indicates that each tank requires a maximum operational capacity of 375,000 gallons to maintain a safety factor of 1.5. The assumptions made in the calculation must be adhered to during operational activities to maintain the calculated safety factor.

5.10 SURFACE STORMWATER

The surface stormwater analysis was done to determine the sizes of the surface stormwater facilities necessary for the IDF Phase I Critical Systems Design. The surface stormwater analysis is documented in detail in Appendix C.9.

The governing regulation is WAC 173-303-665 (2) (c) and (d). This requires that the stormwater system be designed to prevent flow onto the active portion of the landfill during peak discharge from at least a 25-year storm. It also requires that the runoff management system be designed to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

The primary purpose of the proposed stormwater facilities is to prevent stormwater runoff from areas adjacent to the two Phase I cells from entering the cells during Phase I operation. This will be done by collecting, conveying, and safely discharging stormwater from areas outside of the two Phase I cells that would otherwise run into these cells.

The Department of Ecology has issued State Waste Discharge Permit Number ST 4510 for industrial stormwater discharges to the ground through engineered land disposal structures on the Hanford site (ST 4510, Ecology, 1999; DOE/RL97-67 Revision 3, January 2000). Since the design for this project does include facilities for collecting stormwater runoff and discharging it to the ground, the permit was reviewed to determine whether it applied to these stormwater discharges. To be covered by this permit, the stormwater must be considered an industrial discharge that is collected in an engineered structure and is then discharged to the ground through an engineered structure. A stormwater discharge is an industrial discharge if the stormwater has the potential to come into contact with an industrial activity or is collected within an area of industrial activity. The purpose of the stormwater facilities that have been designed for this project is to prevent the stormwater from areas outside of the Phase I landfill from entering the landfill area. Therefore, the stormwater collected by these facilities would probably not be considered industrial stormwater. To be an engineered structure for the collection of stormwater, the structure has to be an impervious surface that is directly associated with industrial activities. The stormwater collection facilities designed for this project do not have impervious surfaces. Therefore, permit ST 4510 does not apply to the stormwater system designed for this project.

Stormwater facilities were designed only for the operation stage of Phase I and not for interim or final closure conditions. Therefore, no stormwater facilities have been designed for stormwater runoff from the Phase I cells after construction of their interim closure or final closure. Stormwater needs for the construction, operation, and closure of future phases were also not considered.

No stormwater collection and conveyance facilities were analyzed and/or designed for any of the roads and support facilities that will be constructed as part of this project. The roads will be gravel surfaced, and stormwater that does run off the roads into adjacent areas will infiltrate. The stormwater from the roofs of the buildings will be caught in gutters and discharged to the ground surface via down spouts. The stormwater that falls on the leachate tanks will evaporate off the floating covers.

5.10.1 Existing Conditions

Under existing conditions, the area around the Phase I site slopes down gently from south to north at an average grade of approximately 0.5 percent. The only area that may generate stormwater that can run into the Phase I excavation is the area that extends south from the excavation area to the crest of the sand dunes, located north of 1st Street (see drainage areas figure in Appendix C.9). This drainage area is moderately vegetated, primarily with large sage brush and grasses. The soils are generally sandy, with relatively high rates of infiltration. This area typically receives little precipitation. There is little to no runoff, and stormwater normally either infiltrates or is used by the vegetation. No existing drainage channels are apparent. The groundwater table is approximately 300 feet below the ground surface.

5.10.2 Proposed Stormwater Facilities

To prevent stormwater from the area south of the Phase I excavation from running overland into the excavation, a combination stormwater berm/ditch will be constructed south of the top of the south slope of the excavation. The south end of the excavation will be approximately 1,400 feet long, and the ground will be essentially flat. The berm/ditch will have a center high point and then slope down to the east and to the west (two discharge points). A berm will be constructed immediately south of the ditch. At the centerline of the excavation, the invert of the ditch will be at the existing ground surface, and the berm will form the south slope of the ditch. The ditch will be excavated, with a longitudinal slope of 0.5 percent to both the east and the west. This will be done in order to minimize the depth of the ditch at its east and west ends. Culverts will be installed at the east and west ditch ends to convey the flow under the access roads. The culverts will discharge into the east and west infiltration areas.

The base map does not show any areas where stormwater runoff from offsite areas may flow into the east or west boundaries of the Phase I excavation. However, if any offsite stormwater should flow toward these boundaries, the fill for the berm access road and the shine berm will prevent the stormwater from flowing into the excavation (see drainage areas figure in Appendix C.9). The intercepted stormwater will flow south along the toe of the fill and either infiltrate or flow overland to the north, away from the site at the north end of the berm access road.

The ground slopes away from the north end of the Phase I site, so there will be no offsite stormwater running toward the north Phase I boundary.

The Phase I liner will end north of the toe of the south slope of the Phase I excavation. In order to reduce potential leachate flows, a stormwater berm/ditch will be constructed just south of the south end of the liner. This berm/ditch will intercept and convey stormwater runoff from the unlined south slope and the unlined southern ends of the east and west slopes. The berm/ditch will be sloped to drain to the east. A stormwater pipe will convey the stormwater under the landing for the access ramp and will discharge to the excavation infiltration area. If this pipe ran straight from the ditch to the infiltration area, it would not have adequate cover. Therefore, a catch basin with a solid cover will be installed near the west end of the stormwater pipe. The invert of the pipe out of the catch basin will be lower than that of the pipe running into this catch basin. The stormwater pipe that will run from the catch basin to the excavation infiltration area will then have adequate cover. The excavation infiltration area will be excavated in the southeast corner of the excavation.

The south edge of the access ramp into the Phase I excavation and the south edge of the "flat" area at the bottom of the access ramp will also serve as ditches. The access ramp will have a cross-slope of 2 percent down to the south. The "flat" area at the bottom of the access ramp will have a slope down to the south that varies between 1 and 3 percent. Adjacent to each of these will be the south slope of the excavation. Construction of a full V-shaped ditch along the south side of the access ramp and the "flat" area was considered. This idea was rejected because it would result in a larger excavation with the top of the Phase I south slope moved further south.

The stormwater facilities are shown on the Phase I Grading and Drainage Plan drawing (Drawing H-2-830830).

Stormwater runoff from the north, east, and west lined slopes of Phase I will run into the bottom lined area and will become leachate. There are no provisions in the design of the Phase I critical systems to divert clean runoff from these side slopes and discharge it to the surface water system instead of the leachate system at this time. However, a rain curtain or other approach to reduce the amount of clean runoff from the lined area that enters the leachate system may be considered in the future.

5.10.3 Analysis

The surface stormwater analysis is documented in Appendix C.9 and is summarized below.

Stormwater runoff flows were estimated for a 24-hour, 25-year design event, using the Soil Conservation Service curve number methodology as documented in *Urban Hydrology for Small Watersheds* (U.S. Department of Agriculture, June 1986) and the Hydraulic Engineering Cirular-1 (HEC-1) computer program (*Flood Hydrograph Package (HEC-1)*, U.S. Army Corps of Engineers, Hydrologic Engineering Center, revised June 1988). The precipitation data used was based on information from the *Hanford Site Climatological Data Summary 2001* (Pacific Northwest National Laboratory, May 2002). The ground at the project site is periodically frozen during the winter months, when the most precipitation falls. Therefore, it was assumed that the ground was frozen for the runoff flow calculations.

The peak flows (calculated using the HEC-1 model) were checked for reasonableness. The tabular and graphical methods in TR 55 were used to estimate peak 25-year flows for each of the drainage areas modeled in HEC-1. The results confirmed the reasonableness of the peak flows calculated by HEC-1.

The berm/ditches were designed to convey the peak 25-year flow with a minimum freeboard of one foot.

The infiltration areas were sized based on containing and infiltrating the runoff from the 24-hour, 25-year design event, without causing the water surface to extend above the upstream end of the culvert or stormwater pipe that will discharge to the infiltration area. No specific infiltration data have been collected at the IDF project site. However, infiltration rates have been determined for use at the Waste Treatment Plant (*Geotechnical Report Supplement No. 1*, Shannon and Wilson, April 2001). These infiltration rates were used in sizing each of the infiltration areas.

The culverts and stormwater pipes were designed to convey the peak 25-year flow with a maximum headwater to a diameter ratio of 1.25. Both inlet and outlet flow conditions were analyzed. The starting water surface for the outlet flow condition calculations were the maximum water surface elevation estimated for the associated infiltration area for the 24-hour, 25-year design event.

5.11 ACTION LEAKAGE RATE (ALR)

5.11.1 LDS ALR

The ALR is defined in WAC 173-303-665(8) and the Final Rule (EPA 1992a, 40 CFR Part 264.222) as the "maximum design flow rate that the leak detection system…can remove without the fluid head on the bottom liner exceeding 1 foot." This calculation was performed to determine the ALR for the IDF lining system. The IDF consists of two cells, each with an area of approximately 8.5 acres.

In addition to determining the ALR, an estimate of actual leakage rate through the proposed primary bottom lining system is provided as a comparison to the calculated ALR. HELP modeling for the side slope indicates negligible head build-up on the side slopes (see Section 5.8), thus an estimation of the actual leakage rate was determined for the bottom primary lining system only.

EPA provides a formula (based on Darcy's Law for calculating this flow capacity), assuming that it originates from a single hole in the primary liner (EPA, 1992b). Calculations presented in Appendix C.10 provide details of the method of analysis and input data. The ALR calculations are dependent on the transmissivity value for the CDN. A value of 3×10^{-5} m^2/sec was used in the ALR analysis (equivalent to the value required by WAC and EPA regulations for the LDS, Section 5.7.2). Calculations in Appendix C.6.b2 provide justification for the transmissivity used in the ALR analyses.

The results of the analyses indicate the ALR for each IDF cell is 206 gallons per acre per day (gpad) or approximately 1,800 gallons per day per cell. This ALR includes a factor of safety of 2 in accordance with EPA guidelines (EPA, 1992b). It is also much lower than the capacity of the pump that removes liquid from the LDS. The estimated actual leakage rate for the composite primary lining system is 0.06 gpad (small defect) to 0.08 gpad (larger defect) for a composite liner with good intimate contact, and 0.3 gpad (small) to 0.4 gpad (large) for poor contact. Detailed calculations for both rates are presented in Appendix C.10.

The proposed primary composite lining system has a much lower estimated leakage rate than the ALR. This demonstrates the benefit of the GCL that is included in the primary bottom lining system, to provide a composite lining system and minimize actual leakage rate through the bottom primary lining system.

5.12 BUILDING SYSTEMS ANALYSES

5.12.1 Geotechnical Design Parameters

The key geotechnical parameters and analyses for structural design of the supporting facilities for the Hanford IDF included the following:

- Bearing Capacity
- Settlement
- Modulus of Subgrade Reaction
- Earth Pressures
- UBC Seismic Soil Parameters

The methodologies, input data, and results for each of these categories of analysis are presented in detail in Appendix C.11.A.

5.12.2 Structural

5.12.2.1 Crest Pad Building Foundation Analysis, Pipe Bracing and Winch

The crest pad building foundation was analyzed as a concrete slab on an elastic foundation. The foundation was modeled with springs to model the vertical sub-grade reaction. The value of the vertical sub-grade reaction was provided by the geotechnical engineer. The applied loads and load combinations were input into Visual Analysis (version 4.0), a finite element program. The finite element analyses results include elastic settlement, moments, and shears values of the concrete slab. The results were then used to design slab depth and reinforcing.

Load reactions from the pre-engineered metal building were estimated using hand calculations and applied onto the concrete slab at the corners of the slab. It is a reasonable assumption that the frame loads from the pre-engineered metal building will only occur at the corner of the building, since the size of the building will not require any intermediate framing.

Loads and load combinations were used as required by TFC-ENG-STD-06, REV A. Performance category, PC-1 was used as specified and applied as applicable for both wind, seismic, and load combinations requirements.

In summary, the analyses results showed that an 8-inch thick slab sufficed with #5 reinforcing at 12-inch centers. The analyses results also showed that a 1 foot-10 inch edge thickening around the perimeter of the building would be sufficient. More detailed accounting of the analyses is presented in Appendix C.11.b1.

The pipe bracing and support for the small diameter PVC (polyvinly chloride) piping included both gravity as well as lateral load resistance, due to a seismic event. The governing piping support is assumed to be a 6-foot-tall cantilever support, with the piping load and 50 pounds of lateral load applied to the top of the support. The 50 pound lateral load was used in lieu of the calculated seismic load because the calculated seismic load was only 19 pounds. Using a 50 pound lateral load gives the pipe support system greater rigidity. Detailed calculations of the pipe supports are included in Appendix C.11.b2.

The winch support was analyzed as a vertical cantilever that supports the winch and resists a total lateral load of 400 pounds. A 400 pound lateral load was used since the entire gravity load of the pump and the hoses adds up to this weight. Therefore, using 400 pounds in the horizontal direction is conservative. Detailed calculations of the winch support are given in Appendix C.11.b3.

5.12.2.2 Leachate Transfer Building Foundation Analysis

As the leachate transfer building foundation is considered as a slab–on-grade, only hand calculations were performed. Foundation soil reactions were considered to be distributed linearly, then soil pressure distributions were applied to the concrete to calculated the moment and shear values for design of the concrete slab and reinforcing steel.

Load reactions from the pre-engineered metal building were estimated using hand calculations and applied onto the concrete slab along the perimeter of the slab.

Loads and load combinations were used as required by TFC-ENG-STD-06, REV A. Performance category, PC-1 was used as specified and applied as applicable for both wind, seismic, and load combinations requirements.

In summary, the analyses results showed that the 2-foot-6 inch-thick slab with #6 bars at 12-inch centers will suffice and appears to be overdesigned. The 2-foot-6-inch thickness is not based on concrete strength requirements but more for frost depth cover, simplifying the ground forming, and reinforcing bending requirements. Detailed calculations of the analyses are presented in Appendix C.11.c.

5.12.2.3 Leachate Tank Foundation Analysis

The leachate tank foundation is considered to be a concrete ringwall, per AWWA D103-97. The tank gravity loads, including both water load and tank dead loads, were considered in the design of the ringwall.

AWWA D103-97, Factory-Coated Bolted Steel Tanks for Water Storage is not listed in the TFC-ENG-STD-06, REV A. AWWA D100-96, Welded Steel Tanks for Water Storage, is listed; however, this standard does not apply, since the tank will be a bolted steel tank. Therefore, the tank will be designed per AWWA D103-97, Factory-Coated Bolted Steel Tanks for Water Storage.

The analysis of the concrete ringwall and reinforcing is based on the hoop tension on the ringwall from the surcharge of the liquid weight on the soil within the ringwall. In summary, a 4-foot-6-inch-deep by 1-foot-6-inch width ringwall with #7 at 12-inch-longitudinal reinforcing on each face of the ringwall will suffice. Detailed calculations of the analyses are presented in Appendix C.11.d.

5.12.2.4 Truck Loading Station Foundation Analysis and Leachate Loading

The Truck Loading Station foundation was analyzed as a concrete slab on an elastic foundation. The foundation was modeled with springs to model the vertical subgrade reaction. The value of the vertical subgrade reaction was provided by the geotechnical engineer. The applied loads and load combinations were input into VisualAnalysis (version 4.0), a finite element program. The finite element analyses results include elastic settlement, moments, and shears values of the concrete slab. The results were then used to design slab depth and reinforcing.

Loads and load combinations were used as required by TFC-ENG-STD-06, REV A. As required, AASHTO HB-16 loading was used with an HS 20-44 load wheel pattern. For maximum axle load, 40,000 pounds was used instead of 32,000 pounds as required per HS 20-44. An impact factor was also applied as required by AASHTO HB-16.

The wheel pattern loading was arranged in three positions on the slab to yield the maximum moments and shears. Supporting calculations and further discussions are presented in Appendix C.11.e1.

The leachate loading support was analyzed as a post with an horizontal boom attached near the top of the post. The design load included the dead weight of the post, boom, and piping full of water. Wind loads were analyzed per ASCE 7-98. In addition, the lateral load was compared with a 300-pound point load hanging vertically at the end of the boom. The lateral wind load governed for overall overturning at the base of the post; however, the 300-pound point load governed for the boom attachment to the post.

In summary, a 10-inch by 10-inch tube for the post, with a 6-inch by 6-inch tube as the horizontal boom welded to the post will suffice. The geotechnical engineer has verified that a 5-foot-6-inch-deep and 3-foot-diameter concrete encasement around the post will be sufficient for strength and stability. Supporting calculations and further discussions are presented Appendix C.11.e2.

5.12.3 Mechanical/Heating, ventilating, and air conditioning (HVAC)

5.12.3.1 Crest Pad and Leachate Transfer Building

Heating, ventilating, and air conditioning (HVAC) capacities were calculated for the crest pad and leachate transfer buildings. The temperature within the buildings must be controlled within a range to prevent freezing fluids in piping or overheating electronic devices. The HVAC components for the buildings were selected based on the criteria and calculations provided in Appendix C.11.f and C.11.g.

5.12.4 Electrical/I&C

- This section introduces and summarizes the results of detailed electrical engineering calculations included in Appendix C.11.h.
- IDF leachate collection and handling crest pad facilities (two each)
- IDF leachate storage tank and leachate transfer facilities (two each)
- IDF truck loading facilities (two each)

5.12.4.1 Building Power Supply

Open Items

The Phase I Critical Systems 80% IDF design documents do not identify the following open items:

- Exact location of primary 13.8 kV, 3-phase tie-in
- Exact value of available primary short circuit current at primary tie-in location
- Exact length of primary extension
- Exact location, size, and impedance of utility step-down 13.8 kV – 480/277V three, phase, 4-wire pad mounted transformer(s)

These items are scheduled to be addressed during the next IDF Phase I Non-Critical design.

Assumptions

The following assumptions were made in order to complete the 80% engineering analysis.

- Assume electrical service gear inside each Cell 1 and Cell 2 crest pad building to be powered by separate pad mounted utility transformers
- Assume pad mounted utility transformers to be rated 75 kVA and installed within 100 feet of respective Cell 1 and Cell 2 crest pad buildings
- Assume each pad mounted utility transformer to be radial fed from a common 13.8 kV primary feeder
- Assume each Cell 1 and Cell 2 leachate transfer building to be powered from electrical service gear, located inside respective crest pad buildings
- Assume available short circuit at primary side of pad mounted utility transformer(s) to be 100 MVA with an (X/R) ratio equal to 8
- Assume impedance of 75 kVA pad mounted utility transformer to be 3.2%Z, 2.42%IR, and 2.10%IX

- Assume power factor and efficiency for all pump motors to be 85 percent and 82 percent, respectively

- Assume 25 foot candles of lighting levels to be required for interior of each building

Assumptions will be reviewed and addressed during the next IDF Phase I Non-Critical design.

Method of Analysis

- Branch circuit, feeder and service calculations in accordance with NEC Code (2002)

- Short circuit analysis (per unit) in accordance with IEEE-*Red Book,* Standard 141 (1993)

- Grounding electrode analysis in accordance with IEEE-*Green Book,* Standard 142 (1991)

- Computer analysis by SKM PTW 32 (Power Tools for Windows, 2003)

- Building interior lighting zonal cavity method in accordance with Integrated Engineering Software, Inc. (IES) *Lighting Handbook* (2000)

Analysis performed includes:

- Calculate and size service, feeder, and branch circuits, based upon demand and design loads

- Calculate and size equipment, equipment bus amperage, protective devices, and motor overloads, based upon demand and design loads

- Calculate and size power feeders and branch circuit wiring, based upon demand and design loads

- Calculate short circuit ratings for equipment

- Calculate feeder and branch circuit voltage drop, and power factor

- Calculate building lighting system requirements

Voltage Drop

Load flow steady state voltage drop calculations for all feeders were based upon an equipment 85 percent power factor. Wire size were calculated and selected so that circuits do not exceed total voltage drop from the source bus to the point of utilization, including feeders and branch circuits:

Service and sub feeders	2 percent	Heat trace from panels	1 percent
Lighting from panels	1 percent	Receptacles from panels	1 percent
Motors from motor control center (MCC)	1 percent	Instrumentation from panels	1 percent

Feeder and Equipment Sizing

Service, feeder, branch circuit conductor ampacity, and protection devices ratings are based upon applicable sections of the NEC (2002) including:

- Lighting Loads per Article 220: Lighting

- Receptacle Loads per Article 220.13: Non-dwelling Units
- Continuous Loads per Article 230: Service
- Motor Loads per Article 220:14 and 430: Motors
- Air Condition Load per Article 440.6: Refrigerant Motor Compressor
- Heat Loads per Article 200.15: Fixed Electric Space Heating
- Non-Coincident Loads per Article 220.21: Non-coincidental Loads
- Heat Trace per Article 427: Fixed Electric Heating Equipment for Pipelines and Vessels

Load Factors

The following table summarizes load factors applied for various equipment in accordance with appropriate sections of the NEC (2002), while determining demand and design load analysis:

Table 5-4: Building Power Supply Load Factors

Item	Panel and Service Load Analysis	Comment
Heater Loads*	100 percent full load amperage (FLA)	Branch circuit sized to 125 percent of FLA
Motor Loads	Sum of motor load (FLA) + 25 percent of largest motor (FLA)	Branch circuit sized to 125 percent of FLA
Receptacles	180 VA /outlet	Non-Continuous Load
Lighting	2 watts/sq.-ft or total connected (FLA), whichever is larger	Continuous Load
Cooling Loads*	100 percent FLA	Branch circuit sized to 125 percent of FLA
Demand Factors	**Demand Factor Percent**	
First 10 kVA	Non-Dwelling Receptacles	100 percent
Remainder over 10kVA	Non-Dwelling Receptacles	50 percent
Non-continuous Load		100 percent
Continuous Loads		125 percent

* Note: The largest of the non-coincidental heat and cooling loads are used for service sizing.

Table 5-5: Input Data Typical for Cell 1 and Cell 2

Description	Ratings	Comments
Pump 219(Y)-LH-P-202	1/2 HP @ 480V, 3-phase	Coincidental load
Pump 219(Y)-LH-P-203	7.5 HP @ 480V, 3-phase	Coincidental load
Pump 219(Y)-LH-P-204	1/2 HP @ 480V, 3-phase	Coincidental load
Pump 219(Y)-LH-P-205	1/3 HP @ 480V, 3-phase	Coincidental load
Pump 219(Y)-LH-P-207	3 HP @ 480V, 3-phase	Coincidental load
Pump 219(Y)1-LH-P-302	3 HP @ 480V, 3-phase	Coincidental load
Heater 219(Y)-LH-UH-001	3.3 kW @ 480V, 3-phase	Non-coincidental and continuous load*
Heater 219(Y)1-LH-UH-002	3.3 kW @ 480V, 3-phase	Non-coincidental and continuous load*
Air Condition 219(Y)-LH-AC-001	2.04 kVA @ 208V, 1-phase	Non-coincidental load
Air Condition 219(Y)1-LH-AC-002	.96 kVA @ 208V, 1-phase	Non-coincidental load
Control Panel 219(Y)-LH-CP-001	1.5 kVA @ 120V, L-N	Continuous load
Bldg. 219(Y) Lighting	71 kVA @ 120V, L-N	Continuous load
Bldg. 219(Y)1 Lighting	29 kVA @ 120V, L-N	Continuous load
Heat Trace 219(Y)201-LH-HT-001	77 kW @ 120V, L-N	Continuous load
Heat Trace 219(Y)201-LH-HT-002	77 kW @ 120V, L-N	Continuous load
Heat Trace 219(Y)1-LH-HT-003	77 kW @ 120V, L-N	Continuous load
Bldg. 219(Y) Receptacles	720 kVA @ 120V, L-N	180VA/ outlet
Bldg. 219(Y)1 Receptacles	360 kVA @ 120V, L-N	180VA/ outlet

Note: (Y) = A,E
Cell 1 (A), Cell 2 (E)
* Heater Load is greater than AC load.

Table 5-6: Building Power Supply: Results/Conclusions

Description	Ratings
Bldg. 219(X) connected load @ 219(X)-LH-MCC-001	23 kVA connected – 26 kVA design for each crest pad building.
Bldg. 219(X) main service breaker size @ 219(X)-LH-MCC-001	100 amps
Bldg. 219(X) main service feeder to 219(x)-LH-MCC-001	3#1 TW, 1#1 TW (N)
Bldg. 219(X) service transformer	75 kVA, 480V, 3-phase, 4-wire
Bldg. 219(X)1 transfer bldg. feeder breaker size	50 amps
Bldg. 219(X)1 transfer bldg. feeder size	3#4 TW, 1#8 G
219(x)-LH-MCC-001 short circuit available	2,484 amps symmetrical
219(x)1-LH-SW-002 short circuit available	1,632 amps symmetrical
219(x)-LH-LP-001 short circuit available	1,177 amps symmetrical
219(x)1-LH-LP-002 short circuit available	1,068 amps symmetrical
219(X) –LH-LP-001 lighting panel rating	60 amps
219(X)1-LH-LP-002 lighting panel rating	60 amps
219(X)-LH-T-001 lighting panel transformer rating	15 kVA
219(X)1-LH-T-002 lighting panel transformer rating	15 kVA
219(X)-LH-P-203 LCRS high flow pump motor feeder size	3#12 TW, 1#12 G
219(X)-LH-P-202 LCRS low flow pump motor feeder size	3#12 TW, 1#12 G
219(X)-LH-P-204 LDS pump motor feeder size	3#12 TW, 1#12 G
219(X)-LH-P-205 sump pump motor feeder size	3#12 TW, 1#12 G
219(X)1-LH-P-302 transfer pump motor feeder size	3#12 TW, 1#12 G
219(X)-LH-P-207 combined sump pump motor feeder size	3#12 TW, 1#12 G
219(X)-LH-UH-001 unit heater feeder size	3#12 TW, 1#12 G
219(X)1-LH-UH-002 unit heater feeder size	3#12 TW, 1#12 G
219(X)-LH-AC-001 air condition feeder size	3#10 TW, 1#10 G
219(X)1-LH-AC-002 air condition feeder size	3#12 TW, 1#12 G
219(X)-LH-MD-001 motor damper feeder size	2#12 TW, 1#12 G
219(X)1-LH-MD-002 motor damper feeder size	2#12 TW, 1#12 G
219(Y)201-LH-HT-001 leachate storage tank heat trace	2#10 TW, 1#10 G

Table 5-6: Building Power Supply: Results/Conclusions

Description	Ratings
feeder size	
219(Y)201-LH-HT-002 leachate storage tank heat trace feeder size	2#10 TW, 1#10 G
219(Y)1-LH-HT-003 truck loading station heat trace feeder size	2#10 TW, 1#10 G
219(X)-LH-CP-001 main control panel feeder size	2#10 TW, 1#10 G

Note: (X) = A,E

Building Power Supply

- Provide separate power distribution equipment (pad mount utility transformer, secondary service, and power distribution gear) for Cell 1 and Cell 2 in order to maximize redundancy.

- Install service rated motor control center inside each crest pad building for the purpose of providing service entrance, branch, and sub-feeder distribution capability, and complete motor control for various process control systems.

- Power lighting, receptacle, and facility loads from 3-phase, 4-wire lighting panel installed in each building.

- Power instrumentation from surge protected distribution center mounted inside facility control panel.

Ground Electrode System

- Provide and install ground electrode system for service and each separately derived system that incorporates both ground ring, ground rod, and concrete encased building rebar.

- Provide ground bus inside Process Instrumentation and Control Systems (PICS) control panels and bond to common ground electrode system.

- Bond non-current carrying metallic structure to ground electrode system that has the potential of becoming energized by attached electrical devices such as metallic conduit systems, enclosures, storage tank structures, building metal framing and siding, and above grade metallic process equipment.

5.12.4.2 Crest Pad Building Lighting

Building lighting systems were based upon I.E.S Zonal Cavity method in order to maintain an average 25-foot-candle level for process interior of each building.

Note: *Interior lighting levels are based upon IES Lighting Handbook Indoor Industrial Areas Recommended Illuminance Levels for interior activities inside work spaces where visual tasks of medium to large contrast are to be performed on occasional basis.*

Note: *Exterior entrance lighting levels are based upon IES Lighting Handbook Outdoor Site/Area Recommended Illuminance Levels for building exterior entrances frequently visited locations.*

Open Items

None

Assumptions

The following assumptions were made when analyzing building lighting.

Reflectance for unfinished rooms:

Ceilings	50 percent reflectance

Walls	50 percent reflectance
Floors	20 percent reflectance

Maintenance factor (light loss factor), interior lighting:

Incandescent lighting	.80
Fluorescent lighting	.61
HPS lighting	.70

Maintenance factor (light loss factor), exterior lighting:

HPS lighting	.70

Inputs

Crest pad buildings are unfinished industrial buildings with interior dimensions of:

Room name: Cell 1 crest pad building	Ceiling height: 11 feet
Fixture type: fluorescent two-lamp	Mount height: 9 feet
Room size: width 16 feet and length 21 feet	Area: 336 square feet

Recommendations

- Provide fluorescent low temperature starting wrap-around industrial fixtures for interior lighting of buildings
- Use two lamps in six fixtures for 25-foot candles minimum
- Install low pressure sodium fixture at front entrance on north exterior wall

5.12.4.3 Leachate Transfer Building Lighting

Building lighting system was based upon I.E.S Zonal Cavity method in order to maintain an average 25-foot-candle level for process interior of each building.

Note: *Interior lighting levels are based upon IES Lighting Handbook Indoor Industrial Areas Recommended Illuminance Levels for interior activities inside work spaces where visual tasks of medium to large contrast are to be performed on occasional basis.*

Note: *Exterior entrance lighting levels are based upon IES Lighting Handbook Outdoor Site/Area Recommended Illuminance Levels for building exterior entrances frequently visited locations.*

Open Items

None

Assumptions

The following assumptions were made when analyzing building lighting.

Reflectance for unfinished rooms:

Ceilings	50 percent reflectance
Walls	50 percent reflectance
Floors	20 percent reflectance

Maintenance factor (light loss factor), interior lighting:

Incandescent lighting	.80
Fluorescent lighting	.61
HPS lighting	.70

Maintenance factor (light loss factor), exterior lighting

HPS lighting	.70

Inputs

Crest pad buildings are unfinished industrial buildings with interior dimensions of

Room name: leachate transfer building — Ceiling height: eight feet

Fixture type: fluorescent two-lamp — Mount height: eight feet

Room size: width 10 feet and length 10 feet — Area: 100 square feet

Recommendations

- Provide fluorescent low-temperature starting wrap-around industrial fixtures for interior lighting of buildings
- Use two lamps in two fixtures for 25-foot candles minimum
- Install low pressure sodium fixture at front entrance on north exterior wall and low pressure sodium on south exterior wall

5.12.4.4 Uninterrupted Power Supply (UPS) Sizing

Uninterruptible power is provided and sized to provide 25 minutes minimum of continuous backup power to the PICS programmable logic controller (PLC), operator interface unit (OIU), and local area network communication equipment.

In the event of a power failure, UPS will maintain communication with remote monitoring sites (future) and insure safe shutdown of power sensitive PICS equipment.

Open Items

None

Assumptions

None

Table 5-7: Input Data Typical for Cell 1 and Cell 2 Control Panel Loads

Description	Ratings	Comments
PLC Power Supply	180 VA	Continuos load
OIU Power Supply	60 VA	Continuous load
Ethernet Switch Power Supply	44 VA	Continuos load
Total *1.25	**355 VA**	

Recommendations

Table 5-8: Fortress Runtimes for Typical Applications in Minutes

Load (VA)	50	100	200	300	400	500	600	750	900	1050	1250	1425	1800	2250

0520-1050U	200	125	63	42	31	24	19	14	11	9.5	-	-	-	-
0520-0750U	132	75	38	26	19	14	11	8.5	-	-	-	-	-	-

Provide 1050 VA 120 Volt- 120 Volt UPS to achieve the 25 minutes minimum of continuous backup, power in the event of a power failure. Additional capacity will compensate for battery cycling deprivation.

5.13 CIVIL GRADING

5.13.1 Waste Volume, Cut/Fill and Stockpile Requirement Calculations

The IDF is designed to provide the waste volume requirements identified by CH2M HILL. Those requirements consist of an ultimate landfill capacity for 1,177,110 cubic yards of waste and a Phase I capacity of 213,515 cubic yards of waste.

The IDF is also designed to balance the cut and fill volumes of the project. The ultimate landfill layout on the project site provides this balance. The volume balance includes excavated material which will be used for the construction of the closure cap. Since the closure cap will be selected and designed in the future, assumptions for the cap layout and construction were made.

With a phased construction approach planned for IDF and the fact that the material balance includes backfill to construct a closure cap for the ultimate landfill, a substantial volume of material will be stored in stockpiles at the completion of construction of Phase I landfill. The Phase I landfill design volumes for subgrade cut, admix liner, drain gravel, and operations layer material were calculated using a 3-D AutoCAD model of the landfill. These volumes were used to identify the stockpile requirements to store material once Phase I construction is complete.

Potential stockpile locations are identified on the project site plan. Calculations of these volumes are included in Appendix C.12.a. Calculations in Appendix C.12.a also present confirmation of the available waste volume and cut/fill balance.

5.13.2 Phase I Access Road and Ramp Cross Section Design

Two cross sections using granular material for base and top course were designed for the Phase I landfill access roads and the access ramp into the landfill. The design reflects the estimated wheel loads and vehicles to use the facility daily. Calculations presenting the development of these cross sections are included in Appendix C.12.b.

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6.0 FACILITY DESIGN AND CONSTRUCTION

6.1 FACILITY LAYOUT

6.1.1 Location

The IDF will be located approximately 1,400 feet east of Baltimore Avenue and directly north of 1st Street in the 200 East Area of the Hanford Site. Phase I of the IDF landfill will measure approximately 800 feet by 1,500 feet, with its north-south axis being the shorter dimension. Leachate handling facilities will be located immediately north of the Phase I cells. The excavated depth to subgrade (not including sump depressions) will range from approximately 44 to 51 feet. Excavation will be deepest at the landfill's north end, near the sumps and along the centerline of each cell. It will be shallowest at the southwest and southeast corners of Cells 1 and 2, respectively. Stockpile locations for excavated materials will be situated east and southeast of the Phase I landfill excavation. At the completion of Phase I construction, exposed surfaces of the stockpiles and disturbed areas will be covered with a layer of topsoil, then seeded and mulched. A borrow area of soil to supplement admix preparation is located south of the Phase I excavation location.

6.1.2 Access Roads and Ramps

For access to Phase I of the IDF, waste hauler and operations vehicles will follow an access road and travel north from 1st Street. All roads and ramps at the Phase I IDF site will be constructed with crushed surfacing material for the base and top courses. The access road from 1st Street will be aligned with the landfill's west berm access road. The road will also follow the alignment of the west access berm road for the future IDF cells.

The access road will lead north, approximately 1,000 feet from 1st Street to where it widens into an intersection. At this location, a turn to the east will lead down a 5 percent grade, 800-foot-long access ramp into the Phase I landfill. The access ramp slope was selected to allow use by both waste haul trucks and the melter transporter. The grade of the access road from 1st Street was also limited to a maximum of five percent for this same reason. The access ramp into the landfill and the access road from 1st Street to the intersection area will be both 30 feet wide.

At that base of the ramp into the landfill, there will be adequate room for waste haul vehicles to turn and move the waste into the cells. The liner system will be installed to extend approximately 50 feet south beyond the estimated toe of slope of Phase I waste placement. This extension will allow waste haul vehicles to be staged or unloaded over a lined area.

At the access road intersection, continuing north will lead up a short ramp and onto the berm access road. The berm access road will be 20 feet wide on the east and west sides of the landfill. The road will widen to 30 feet at the northwest and northeast corners of the landfill and along the landfill's north side. The wider road in these areas will allow operations vehicles to traverse around road corners and the crest pad buildings.

The access road will continue from the northwest corner of the berm access road to the Cell 1 and Cell 2 leachate storage tank facilities. A cul-de-sac area will be provided just east of the Cell 2 leachate facilities to provide a turnaround area for operations vehicles and leachate tanker trucks. A road will also be provided to allow operation vehicles to travel south between the leachate facilities and onto the berm access road at the centerline of IDF landfill.

Future projects are being planned to upgrade the 1st Street pavement and construct an operation building north of the IDF landfill. It is anticipated that these facilities will connect to access roads designed for the Phase I landfill.

Related to permanent access roads and their use, the construction contractor will be required by the project general requirements to submit a plan which details their use during construction. This plan will address locations and limits of stripping/grubbing, construction haul roads, stockpile/borrow areas and other construction staging areas.

6.1.3 Survey Grids

Survey grids for this project use the Washington State Plane coordinate system (South Zone–feet, NAD83 Lambert Projection).. Contours are based on 200 Area topographic mapping database, provided by Hanford HGIS Department and dated 1991. A 1-foot contour interval was used on the design drawings.

As part of the Phase I landfill design, construction control points were developed for landfill and sump subgrades as well as for the anchor trenches, stormwater facilities, and the finished grades for all roads and ramps. North and east coordinates and elevations for these points are included in a survey control table on Drawing H-2-830829, Sheet 2 of 2. The control points and lines between them will provide a location grid that will allow construction of the subgrade, liner system, operations layer, and the finished grades for the IDF.

6.2 LANDFILL GEOMETRY

6.2.1 Waste Volumes and Types

6.2.1.1 Volume

Two key design criteria were provided by CH2M HILL concerning waste volumes:

- Phase I of the IDF should be designed to receive a waste volume of 213,515 cubic yards, which is equal to163,250 cubic meters. CH2M HILL identified the waste volume for placement in all phases of IDF (ultimate landfill size) as 1,177,110 cubic yards, or 900,000 cubic meters.
- Both the Phase I landfill and the ultimate landfill volumes should be sized for an air space which includes 1.5 cubic yards of clean fill for every cubic yard of waste.

Using these criteria, Phase I was designed to provide air space for placement of 533,620 cubic yards of waste and clean fill.

6.2.1.2 Waste Types (Note: The disposal of MLLW other than ILAW, DBVS waste, and IDF generated waste is not permitted at this time by this permit.)

The IDF will receive waste types including ILAW, DBVS Waste, and LLW. These wastes include both contact and remote-handled wastes. As identified in the project kickoff meetings by CH2M HILL, the waste volumes (in cubic yards) are estimated to include the following:

Waste Type	Phase I	All Phases
ILAW	50,025	753,350
MLLW	57.550	146,485
LLW	105,940	277,275
Total	**213,515**	**1,177,110**

These volumes are based on waste forecast information provided by Fluor Hanford, Inc. (FH). The waste volume forecasts are updated by Hanford Site contractors on a regular basis. The volumes above represent an average between the FH 2002 Forecast and the FH 1999 (with EIS) Forecast. A short description of the waste types are given below:

Immobilized Low-Activity Waste (ILAW)–The ILAW packages are stainless steel cylinders that have been filled with vitrified low-activity waste (physically similar to glass), sealed, and cooled. The source of these waste cylinders is the Waste Treatment and Immobilization Plant. The packages are 7.5 feet in height and 4 feet in diameter, and could weigh up to 22,050 pounds each.

Contact-Handled Mixed Low-Level Waste (CH MLLW)–This waste has a dose rate equal to or less than 200 mrem/h and contains radioactivity not classified as high-level waste, spent nuclear fuel or transuranic (TRU) waste (TRU is defined as concentrations of transuranic radionuclides greater than or equal to 100nCi/g of the waste matrix). The waste is also defined as dangerous (hazardous) waste in WAC 173-303.

Remote-Handled MLLW – This waste has a dose rate greater than 200 mrem/h and contains radioactivity not classified as high-level waste, spent nuclear fuel, or TRU waste. The waste is also defined as dangerous (hazardous) waste in WAC 173-303.

Low-Level Waste Category I (LLW I)–This waste contains radioactivity not classified as high-level waste, spent nuclear fuel, or TRU waste. The waste also meets the radionuclide limits for category I waste, defined in the *Hanford Site Solid Waste Acceptance Criteria* (RH, 1998). This waste may be comprised of either contact- or remote-handled waste considered low-activity waste with very low concentrations of long-lived radionuclides. This waste is not a dangerous (hazardous) waste as defined in WAC 173-303.

Low-Level Waste Category III (LLW III)–This waste contains radioactivity not classified as high-level waste, spent nuclear fuel, or TRU waste. The waste also exceeds the radionuclide limits for category I waste and meets the category III limits, defined in the *Hanford Site Solid Waste Acceptance Criteria* (FH, 1998). This waste may be comprised of either contact- or remote-handled waste considered moderate- to high-activity waste with low to moderate concentrations of long-lived radionuclides, in stabilized form that minimizes subsidence for a period of 1,000 years. This waste is not a dangerous (hazardous) waste as defined in WAC 173-303.

Remote-Handled LLW – This waste has a dose rate greater than 200 mrem/h and contains radioactivity not classified as high-level waste, spent nuclear fuel, or TRU waste. This waste is not a dangerous (hazardous) waste as defined in WAC 173-303.

6.2.2 Landfill Phases and Dimensions

The IDF will be a single, expandable RCRA Subtitle C disposal facility that provides ultimate capacity for 1,177,110 cubic yards (900,000 cubic meters) of waste. The facility is currently anticipated to be constructed in four phases. Phase I will have two cells. Only Phase I is being permitted at this time. Each cell has a floor width of approximately 543 feet and a lined floor length of 360 feet. The total floor width of the IDF will be 1,085 feet. Side slopes of the landfill will be 3:1 (horizontal:vertical). At the south end of the Phase I cells, there will be a stormwater berm/ditch system with an infiltration area. The south side of IDF will be unlined for Phase I.

IDF will be expanded by relocation of the landfill's unlined south slope from earlier phases and installation of liner system and operations layer. When expanded to its final configuration, the floor of IDF will be 1,385 feet long, measured along its north-south axis.

6.2.2.1 Depth and Length

The landfill depth for all phases of the IDF is set to accommodate four layers of ILAW waste packages, placed on end, and each layer will be covered with 3.3 feet of clean soil. In some cases, the waste packages received for placement in the mixed and low-level waste side of IDF will have heights that vary from the ILAW package dimensions. In these cases, waste heights will vary from the four layers of ILAW waste described. The total depth, measured from the top of the operations layer to the top of the cover layer over the fourth waste layer, will be 43.4 feet. This is sized for the 7.5-foot tall ILAW package dimension. However, other waste package types can be accommodated. The waste/clean fill depth (43.2 feet) will be uniform over the entire landfill floor, due to the operations layer and the top of the landfill both sloping up 1 percent from north to south. The operations layer will be flat in the east-west direction.

6.2.3 Materials Balance

The IDF was designed to achieve near soil balance. This will minimize excess soil stockpile at the end of the life of the IDF facility and minimize the cost of hauling offsite borrow material for construction. It is important to note that the soil balance was calculated for completing IDF through all its phases and the balance included soil required for construction of the final closure cap. The closure cap design was not part of the critical systems design, completed for this project.

Having a soil balance at the completion of all phases means that at the end of Phase I, a substantial amount (approximately 991,000 cubic yards) of material will be stockpiled onsite. The project design identified potential stockpile sites that were adequate in size for the material to be stockpiled. A portion of the stockpiled material will be used as clean fill during the waste placement in the Phase I cells. However, the stockpile will be replenished during the construction of cells for each subsequent IDF phase.

A description of the resulting soil cut and fill volumes can be found in Appendix C.12.a of this Design Report.

6.2.4 Erosion Control Measures

Permanent erosion control measures (for both wind and water caused erosion) will be provided for areas disturbed by Phase I construction.

Areas that are disturbed by the construction that are outside of the Phase I excavation will be stabilized with a 6-inch-thick layer of topsoil that will be seeded with grass. The south stormwater berm/ditch, the east and west infiltration areas, and the soil stockpiles will also be stabilized with topsoil and grass.

Geotextile and quarry spalls will be placed around each end of the culverts and the stormwater pipe to provide erosion protection.

Stormwater runoff will be conveyed along the south side of the access ramp and the south side of the flat area at the bottom of the access ramp, and will be discharged to the southwest corner of the excavation infiltration area. Road surfacing will reduce the erosion potential on the ramp and flat area. To prevent erosion of the south side slope adjacent to the ramp and flat area, a strip of erosion control matting will be installed on the south side slope, immediately adjacent to the ramp and flat area. Geotextile and quarry spalls will be placed in the southwest corner of the excavation pond in order to minimize the potential of erosion due to the stormwater that will be discharged from the south edge of the flat area to the top of the infiltration area.

Erosion control matting will also be placed on the shine berm to minimize the potential for wind erosion. The erosion control matting will be a plastic matting with an estimated service life at least equal to the 10-year period that the Phase I cells are expected to operate.

To reduce wind erosion, all of the side slopes of the Phase I excavation will be stabilized with a spray-on application of a soil stabilization material. Additional applications of the soil stabilization material may have to be done annually on the areas that remain exposed.

The contractor will also be required to prepare and implement a dust control plan for the construction.

6.3 LINING SYSTEM MATERIALS

6.3.1 Liner Selection Basis

WAC 173-303-665(2)(a)(i) requires submittal of an engineering report with the permit application under WAC 173-303-806wac173-303-806(4) stating the basis for selecting the liner(s). The report must be certified by a licensed professional engineer. The intent of Section 6.3 of the Design Report is to satisfy this requirement of the WAC 173-303, Dangerous Waste Regulations.

Specific requirements to addressed as the basis for liner selection include:

- The liner must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation.
- The liner must be placed on a foundation or base that is capable of providing support to the liner and is able to resist pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift.
- The liner must be installed to cover all surrounding earth likely to be in contact with waste or leachate.
- The lining system must include a LCRS immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the landfill. Design and operating conditions will ensure that the leachate depth over the liner does not exceed 1 foot. The LCRS shall be:

    1. Constructed of materials that are chemically resistant to the waste managed in the landfill and the leachate expected to be generated, and of sufficient strength and thickness to prevent failure under the pressures exerted by overlying wastes, waste cover materials, and any equipment used at the landfill.
    2. Designed and operated to function without clogging through the scheduled closure of the landfill.

Engineering analyses were presented in Section 5 that address the above requirements for basis of lining selection. Of particular note is Section 5.6 that addresses lining system/leachate compatibility for all components of the lining system. Compatibility of the lining system components with the chemical and radiological constituents of the expected leachate is a critical aspect of the liner selection basis.

Based on results of the engineering analyses presented in Section 5, the following liner sections are proposed for the IDF bottom (floor) and side slope lining systems. Section 6.3.2 provides a detailed discussion of the liner materials for the barrier components of the lining system, and Section 6.3.3 provides a detailed discussion of the liner materials for the drainage and protection components of the lining system.

Drawing H-2-830838 (Detail 1) shows the bottom liner section, consisting of the following components, from top to bottom:

- A 3-foot-thick operations layer
- A separation geotextile (polypropylene)
- A 1-foot-thick leachate collection drain gravel layer
- A minimum 12 oz/square yard cushion geotextile (polypropylene)
- A 60-mil textured primary HDPE geomembrane
- An internally-reinforced GCL
- A CDN drainage layer for the LDS
- A 60-mil textured secondary HDPE geomembrane
- A 3-foot-thick low-permeability compacted admix (soil-bentonite) liner

Drawing H-2-830838 (Detail 2) shows the side slope liner section, consisting of the following components, from top to bottom:

- A 3-foot-thick operations layer
- A CDN drainage layer for the LCRS
- A 60-mil textured primary HDPE geomembrane
- A CDN drainage layer for the LDS
- A 60-mil textured secondary HDPE geomembrane
- A 3-ft-thick low-permeability admix liner

6.3.2 Liner Materials – Barrier Components

6.3.2.1 Geomembranes

WAC 173-303-665(2)(h)(i) requires that the IDF lining system have both a primary and secondary geomembrane. The geomembrane for the IDF will serve as leachate barrier and as a flow surface routing leachate to the LCRS sump (for the primary geomembrane) or LDS sump (for the secondary geomembrane).

HDPE has been selected as the geomembrane liner material because it is generally acknowledged to have the highest chemical resistance of commercially-available liner materials, has been widely used at similar facilities, and has a high level of acceptance by regulatory agencies. Details of HDPE geomembrane compatibility with expected leachate is discussed in Section 5.6

A nominal thickness of 60-mil has been selected for the HDPE geomembrane. A nominal thickness of 60-mil results in a minimal allowable thickness of 54-mil, as indicated in the technical specifications. Thus, 60-mil nominal thickness is the minimum required to achieve the 50-mil minimum thickness specified by Ecology guidance. Textured (roughened) geomembrane will be used to maximize shear strength along adjacent interfaces and to reduce the potential for sliding of the liner system. Analyses of the various stresses that the geomembrane is designed to withstand under construction and operational loads are presented in Section 5.5. Required material properties as a result of these analyses are included in the technical specifications.

Details of required HDPE geomembrane properties are provided in the technical specifications (see Section 02661).

6.3.2.2 GCL

A GCL will only be included in the primary bottom lining system. For the bottom lining system, both the primary and secondary liners will be a composite (geomembrane over admix liner or GCL) system. The addition of a GCL in the primary lining system will provide an extra measure of protection, exceeding the requirements of WAC 173-303-665(2)(h)(i) for a single geomembrane for the primary liner and composite for the secondary only. This will provide an extra measure of protection on the bottom flatter slopes of the IDF, where higher leachate head levels are more likely. A GCL will not be included on the side slope lining system. The 3H:1V side slopes for the IDF will result in little or no leachate head expected on the side slope lining system, thus eliminating the need for a lining system design that exceeds the WAC requirements.

Commercially-available reinforced GCL products consist of bentonite sandwiched between a woven and non-woven geotextile that are then needle-punched together. Other combinations of upper and lower, woven and non-woven geotextiles can also be manufactured and specified.

For the IDF lining system, a needle-punched, reinforced GCL with non-woven geotextiles on both sides was selected. This type GCL product was selected primarily because of the tensile strength requirements required for landfill global stability (Section 5.1.3). The tighter weave non-woven geotextile minimizes the amount of bentonite that migrates to the interface with the geomembrane, thus minimizing the potential to create a slip surface.

Details of required GCL properties are provided in the technical specifications (see Section 02667).

6.3.2.3 Admix Liner

Details of the admix design test program are provided in Sections 4.2.2 and 5.4.1. Placement and testing requirements are described in Section 5.4.2.

The admix liner will have a minimum 3-foot thick compacted soil/bentonite admixture and will be located immediately beneath the secondary HDPE geomembrane, as required by WAC 173-303-665(2)(h)(i)(B). The admix liner typically will consist of base soil mixed with a nominal 12 percent sodium bentonite, by dry weight. Mixing and processing of the base soil/bentonite admixture is required to be performed under carefully controlled conditions, using a pugmill operation.

The base soil for the admix liner will consist of natural soil, derived from the dune sand borrow area to the south of the Phase I cell (as shown on Drawing H-2-830828) or from within Phase I cell excavations. Based on the results of the limited field exploration for near surface base soil samples (discussed in Sections 4.1 and 4.2), base soil from either source will not be excavated below a depth of 5 feet bgs (after stripping) without further evaluation of the material suitability.

Base soil excavated from the dune sand borrow area or site excavation will meet the following requirements:

- The base soil will be free of roots, woody vegetation, frozen material, rubbish, and other deleterious material.

- Rocks greater than 1 inch in dimension will not comprise more than 2 percent by weight of the base soil.

- Base soil will have 20 percent minimum passing a No. 200 U.S. sieve.

The in-place hydraulic conductivity of the admix liner will be 10^{-7} centimeters per second or less, consistent with WAC requirements for secondary soil liners. The upper surface of the admix liner will be trimmed to the design grades and tolerances. The surface will be rolled with a smooth steel-drum roller to remove all ridges and irregularities. The result will be a smooth, uniform surface on which to place the overlying geomembrane liner.

Before production installation of the admix liner, a full-scale test pad of the admix liner will be conducted for both the bottom floor (horizontal) and side slope areas of the IDF. Details of the test pads are provided in the technical specifications (see Section 02666) and the IDF Construction QA Plan. The primary purpose of the test pad(s) will be to verify that the specified soil density, moisture content, and hydraulic conductivity values will be achieved consistently, using proposed compaction equipment and procedures. In-place density will be measured using both the nuclear gauge (ASTM D2922) and rubber balloon (ASTM D2167) or sand cone (ASTM D1556) methods. In-place hydraulic conductivity will be determined from a two-stage borehole permeameter (ASTM D6391). Admix liner hydraulic conductivity will be estimated from thin-wall tube samples (ASTM D1587) obtained from the test fill and tested in the laboratory (ASTM D5084). During construction, field density (e.g., ASTM D2922, D2167, and/or D1556) and moisture content (ASTM D2216) will be measured periodically. Thin-wall tube samples (ASTM D1587) will be taken at regular intervals and will be tested for hydraulic conductivity (ASTM D5084). Additional details of Construction QA testing and acceptance during admix liner test pad and production installation is provided in the IDF Construction QA Plan.

Details of required admix liner properties and placement requirements are provided in the technical specifications (see Section 02666).

6.3.3 Liner Materials–Drainage and Protection Components

6.3.3.1 Geotextiles

Two types and weights of geotextiles will be used in the IDF project. The separation (Type 1) geotextile has a nominal weight of 6 ounce/square yard and was selected based on the ability of the geotextile to retain the soil and to prevent the soil from entering the LCRS drain gravel. Required AOS and permittivity were determined based on filter, fines retention, and clogging potential criteria. The waste disposed in the IDF is expected to contain a minimal amount of organic material, and consequently, biologic clogging is not expected to be a problem.

The cushion (Type 2) geotextile has a nominal weight of 12 ounce/square yard and was selected based on providing the required cushion protection for geomembrane on the landfill bottom (floor). The drain gravel will have the potential to produce localized stress on the geomembrane liner during gravel placement with construction equipment and under the maximum static pressure from landfill contents at full waste height with final cover. A puncture analysis was performed to select a sufficiently thick geotextile to protect the liner. This analysis included the maximum load from landfill contents and final cover, expected construction vehicle ground pressures, and maximum drain gravel particle size listed in the technical specifications.

Both types of geotextiles are specified as non-woven needle-punched and made from polypropylene material. This material was selected because of its higher chemical resistance to the expected leachate (Golder Associates, 1991a).

Details of required geotextile properties are provided in the technical specifications (see Section 02371).

6.3.3.2 CDN

The CDN is a drainage geocomposite consisting of a HDPE geonet core with a layer of non-woven polypropylene geotextile thermally bonded to each side. The CDN selected for the IDF lining system has two drainage related functions. On the side slopes, it will function as the LCRS. A CDN is selected for the LCRS on the side slope to avoid construction stability problems associated with placement of clean granular material on slopes, thereby minimizing the potential for damaging the underlying liner system. Localized placement of drain gravel is required on side slopes (as shown on Drawing H-2-830848, Section C), to provide adequate backfill and bedding for leachate collection riser piping. On the side slope and bottom lining system, the CDN will function as the LDS.

Analyses were performed to evaluate the geotextile puncture requirements for the LCRS CDN on the side slope and the transmissivity requirements for both the LCRS and LDS CDN. These analyses and discussion are presented in Section 5.7.

The analyses for CDN geotextile puncture resistance determined that the specified geotextile is adequate for resistance to puncture from overlying operations layer, under the maximum static pressure from landfill contents.

The analyses for allowable transmissivity with applied reduction factors for intrusion, creep, and chemical and biological clogging determined that a higher flow, thicker (250 mil minimum) CDN is required, due to the reduction of flow under the high normal loads in the final filling configuration.

Details of required CDN properties are provided in the technical specifications (see Section 02373).

6.3.3.3 Drain Gravel

The LCRS for the bottom liner will be located below the operations layer and will provide a flow path for the leachate flowing into the LCRS sump and sump trough. Between the operations layer and the underlying drain gravel, a geotextile layer will function as a filter separation geotextile (as discussed in Section 6.3.3.1). The separation geotextile will prevent migration of fine soil and clogging of the drain gravel. The gravel will be a minimum 1-foot thick layer of washed, rounded to subrounded stone, with a hydraulic conductivity of at least 10^{-2} cm/sec, as required by WAC 173-303-665(2)(h)(iii)(B). In addition, a slotted HDPE leachate collection piping will be placed within the drain gravel to accelerate leachate transport into the LCRS sump during high precipitation events. Slots on the leachate collection piping are sized to be compatible with the drain gravel gradation and particle sizes. Details of the leachate collection piping design are provided in Section 6.4.1.

Based on review of expected subsurface conditions for the IDF, it is not likely that material meeting drain gravel is available on or near the site. Thus, drain gravel will have to be an imported material. The technical specifications require that drain gravel meet the requirements of WSDOT Standard Specification 9-03.12(4) for gradation. The technical specifications also require a performance specification for a hydraulic conductivity greater or equal to 10^{-1} cm/sec.

As discussed in Section 5.7.3, the minimum estimated hydraulic conductivity for the drain gravel exceeds the required (by WAC regulations) hydraulic conductivity of 10^{-2} cm/sec by a factor or 100 to 1,000, and the performance specification hydraulic conductivity of 10^{-1} cm/sec by a factor of 10 to 100. This allows for uncertainty in the empirical formulas used to predict hydraulic conductivity, and the potential for long-term reduction in hydraulic conductivity in the drain gravel, if fines from waste filling and the operations layer migrate into this layer over time.

Details of required drain gravel material properties are provided in the technical specifications (see Section 02315).

6.3.3.4 Operations Layer

The purpose of the operations layer will be to protect the underlying lining system components from damage by equipment and waste canisters during IDF construction and operation. This layer also will protect the admix liner from freeze/thaw damage and desiccation cracking. This is especially the case on the side slopes, expected to be exposed (prior to waste placement) for longer duration than the bottom (floor) of the IDF cell.

The operations layer material typically will consist of onsite granular soil from the IDF Phase I excavation. The excavated material is expected to be a fine-grained sand to silty sand with traces of gravel. The technical specifications require the material to have a maximum particle size limit of two inches or less, and fines will be limited to maximum 25 percent fines (percent passing the U.S. No. 200 sieve). Based on review of expected subsurface conditions for the IDF excavation, the majority of soil excavated from the IDF Phase I excavation is expected to be suitable for use as operations layer without processing. As discussed in Section 4, additional geotechnical exploration within the IDF Phase I limits are recommended prior to construction to verify these findings.

Details of required operations layer material properties are provided in the technical specifications (see Section 02315).

6.4 LEACHATE COLLECTION SYSTEM

The leachate collection system for each cell in Phase I will consist of lateral flow media built into the cell's bottom and side slope liner system, a leachate collection pipe in the center of the cell, a sump at the north end of the cell where all leachate drains, pumps and leachate transfer piping to convey leachate out of the cell, and a network of piping and storage tanks for storing the leachate for later transfer to tanker trucks for offsite disposal. Below the bottom liner and under the LCRS sump area will be an LDS sump, pump, and associated piping. All components for Phase I of the leachate collection system are designed and configured for eventual full development of the IDF through Phase IV.

The type and configuration of the leachate collection system described below has been used successfully at other disposal facilities, and a very similar facility was recently (2002) implemented at the INEEL site near Idaho Falls, Idaho. This ICDF will accept waste with radioactive characteristics and is located in a region with dry weather conditions, similar to Hanford.

6.4.1 Leachate Collection Piping

6.4.1.1 Description

Lateral drainage media (drain gravel in the bottom liner section and CDN in the side slope section of each cell) will convey leachate by gravity to the leachate collection piping and to the LCRS sump area. The leachate collection piping system in both cells will have one 12-inch diameter HDPE slotted pipe running the length of the cell centerline from south to north. This main collector pipe will be sloped at 1 percent and will convey leachate from the south edge of the cell to the LCRS sump at the north end, where the bottom liner will intersect the side slope liner. The main collection pipe will change to solid pipe at the bottom of the side slope and continue up the side slope and terminate at a cleanout, located just south of the crest pad building. Leachate in the sump will be collected through perforated pipes for the LCRS low flow and high flow pumps, which will be 12-inch and 18-inch HDPE slotted pipe, respectively. The riser pipes will protect the pumps and separate them from the surrounding drain gravel, allow removal and re-insertion of the pumps for maintenance, and provide a high inflow-rate screen for leachate to supply the pumps. A small-diameter pipe (housing a transducer to control the on/off levels for the pumps) will run from the LCRS sump up the side slope to the crest pad building.

The slotted portion of the riser pipes will extend from the toe of the side slope to the end of the LCRS sump area. The transducer pipe will also be slotted but for a shorter distance in the LCRS sump, whereupon it will be solid for the remaining distance to the crest pad building. A solid HDPE pipe (of the same diameter as the slotted portion of the pump riser pipes) will extend from the intersection of the side slope and bottom liner to the top of the shine berm where the pipes enter the crest pad building.

Pipe cleanouts will be provided at both ends of the main collection pipe in the center of each cell. The cleanout at the north end of Phase I, near the crest pad building, will be permanently available throughout the life of the IDF to allow access for cleaning and/or video inspection. The cleanout at the south end of the cell will also be available for cleaning and access, but only during the operation of Phase I. It will be removed and the Phase II collection pipe will be butt-fused to the pipe as the Phase II cell is brought online. Ultimately a permanent cleanout will be installed at the south end of Phase IV, to allow cleaning and inspection of half of the collection pipe, with the other half being accessed by the permanent cleanout located at the crest pad building on the north side of Phase I.

Access to the riser pipes for cleanout or inspection, in the unlikely event this is needed, will be through the access points used for removal and re-insertion of the pumps within the crest pad building.

6.4.1.2 Design Considerations

The material chosen for piping within the Phase I lined area was HDPE, made of resin meeting the requirements of ASTM D3350 for PE 3408 material, with a cell classification of 345434C or higher. Design calculations were based on this material and pipe type, which is routinely used for leachate collection and disposal facilities and other applications. The pipe material is well suited for use in disposal facilities because of its high strength, high resistance to degradation from leachate constituents, and superior characteristics compared to all other readily available pipe materials. HDPE compatibility with leachate and the presence of radioactivity in the waste overlying the pipe were evaluated and discussed previously in Section 5.6.

The diameter of the riser pipes was chosen to provide ample clearance for the pumps to be inserted and removed on a routine basis, and specifically so that the pumps will have sufficient clearance when traveling through the angle points at the intersection of the bottom liner and side slope, and clearance at the radius transition from the side slope to the crest pad building. The pumps (described in Section 6.4.3) are specifically designed for this type of leachate collection system, where the riser pipes allow insertion of pumps down a side slope and into a sump area.

Lateral drainage media in the bottom liner and side slope liner, and the leachate collection piping system were chosen and configured to meet the regulatory requirement of no more than 12 inches of leachate head buildup over the sump area of the bottom liner as a result of a 25-year, 24-hour storm event.

The slots in the slotted pipe were designed to both be compatible with the granular material in the drain gravel and to allow a high rate of flow from the surrounding lateral drainage layers into the pipe. Slots were sized at 0.128 inches wide, with five rows of slots spaced equidistant around the perimeter of the pipe, and eleven slots per foot of pipe.

The thickness of the pipes expressed as the SDR (standard dimension ratio) was chosen to resist the highest estimated load for the IDF in its final configuration, including final cover and equipment loading (internal pressure was not a factor since the pipe will convey flow by gravity, and under the expected flow rates the pipes will only be partially full). A SDR of 17 was chosen for all piping to handle the maximum estimated load. In addition, a blanket of manufactured drain gravel will be placed around and to the sides of all collection piping and compacted to a firm, unyielding condition consistent with the soil modulus values used in the pipe loading calculations.

All piping will be butt-fused for maximum strength, and all fittings, whether available molded from the manufacturer or fabricated, will have the same or higher pressure rating than the pipe. During construction, piping will be butt-fused by certified technicians, using welding equipment approved by the manufacturer. All solid pipe will be pressure tested, even though the collection piping will see little or no internal pressure during gravity conveyance of leachate.

6.4.2 Leachate Transfer Piping

6.4.2.1 Description

At each cell, the leachate transfer piping will begin with the piping from the pumps in the LCRS and LDS sumps to the crest pad building. From the crest pad building, transfer piping will connect the leachate transfer building, storage tank, and tanker truck load facility. All underground transfer piping outside the Phase I liner limits will be double contained, that is the pressure pipe conveying leachate between various facilities will be contained in an outer pipe. The pressure pipe in the center of the double containment piping will be termed carrier pipe, while the outer pipe will be termed containment pipe. In the event of a leak in the carrier pipe, the containment pipe or leak detection pipes draining the containment pipes will convey the leakage to a combined sump facility for detection, sampling, and transfer. Any accumulation of leachate in the combined sump will be pumped through a transfer pipe to the storage tank. Piping within the crest pad building, transfer building, truck load facility, and combined sump, will not be double contained because the buildings or facilities will provide secondary containment and have sumps present to remove any leachate that accumulates as a result of leaking pipes or appurtenances. Leak detection pipes draining containment pipes and the leak detection pipe from the storage tank will be single pipes because they only will convey leakage and will not function as transfer piping (required to have double containment).

The transfer piping system also will include valves, fittings, flow meters, and other appurtenances necessary for operational functions for systems described in Sections 6.4.3, 6.4.4, and 6.4.5.

6.4.2.2 Design Considerations

All transfer piping outside of buildings will meet the same requirements as the HDPE pipe chosen for the leachate collection piping (described in Section 6.4.1). Single pipe and containment pipe exposed to earth and traffic loading will be SDR 17, while the carrier pipe, that will not be exposed to earth or traffic loading, will be SDR 21, with a pressure rating of 80 psi and a safety factor of 2 for the highest expected operating pressure in the system (SDR 17 piping has a pressure rating of 100 psi). All piping will be butt-fused except for the transfer piping from the LCRS and LDS sump pumps. This pipe will be HDPE, with quick release fittings to allow removal of the pumps from the sumps. Fittings will be pressure rated and re-useable. As the pumps are withdrawn from the sumps and moved up the riser pipes, each joint in the pipe will be unhinged to allow the pipe to be removed in 8-foot sections.

Piping inside buildings will be PVC, schedule 80, with solvent welded fittings. This pipe and classification is rated for higher pressure than required with a factor of safety of 8. PVC was chosen for application inside buildings because of its relative ease of fabrication with the solvent weld joint system.

Flange connections will be used between pumps and piping; valves and other appurtenances and piping; and joints between PVC and HDPE piping. Appurtenances will include air release valves to allow purging of any air trapped in the piping system, magnetic flow meters for measuring flow to the tanker truck load output and to and from the leachate storage tanks, and valves for flow control and diversion of flow between the various facilities. The flow control scheme and control logic for the transfer piping system are described in Section 6.4.5.

6.4.3 Leachate System Pumps

Three submersible leachate pumps will be required for each cell. For convenience and operational versatility, roller-mounted pumps were selected for all leachate removal facilities. The submersible pumps are standard stainless steel well pumps that have been installed within a screened stainless steel cylinder fitted with rollers. The configuration will allow the pumps to be installed from the crest pad building within riser piping that follows the slope of the landfill until the riser piping bends horizontally to terminate within the cell sump at the toe of slope. This type of pump can be lowered into the leachate sump through the riser pipe and removed as needed, using a winch mounted within the crest pad building. Each pump will have its foot valve removed to prevent freezing or retaining of the leachate in the pump discharge piping. Advantages of this type of pump include easy access for maintenance and inspection, no power equipment required to remove/install, and its small size will lend itself to being inserted within a curved riser pipe and evacuating nearly all of the leachate within the cell sump. Each pump will have the capability to pump either to the storage tank or truck loading station.

6.4.3.1 LCRS Pumps

Two of the three submersible pumps will be installed within the LCRS sump area of each cell above the primary liner. These pumps are required to maintain less than 12 inches of hydraulic head above the primary liner, per regulatory requirements. The pumps will be installed in a 6-inch depression within the LCRS, in order to minimize the area of permanent leachate storage at pump shutoff and allow full pump operation through the 12-inch maximum liner head zone over the primary liner. Only in the localized area of the LCRS sump depression will a maximum leachate head of 18 inches cover the primary liner. The leachate head over the primary liner will be maintained at or below 12 inches in the main sump area and throughout the landfill. One low-flow pump is required for typical pumping of leachate; a high-flow pump is necessary in the event that a large storm (24-hour, 25-year storm event) exceeds the capacity of the low-flow pump.

The selection of the low-flow pump was based on the average leachate flow from the landfill, determined in the leachate production analysis (Section 5.8.1). The analysis indicated that the maximum leachate flow, based on monthly data, is approximately 13 gpm. The hydraulics of the low-flow pump were modeled and a pump was selected, based on the hydraulic characteristics of the piping system and the required flow rate, determined in the leachate system hydraulics analysis (Section 5.9.2.1). An EPG Companies, Inc. (EPG) model WSD 3-3 (or equal) with a 0.5-horsepower motor was selected for the LCRS low-flow pump.

The selection of the high-flow pump was based on the 24-hour, 25-year storm event, determined in the leachate production analysis (Section 5.8.1). The analysis indicated that the high-flow pump capacity necessary to remove the leachate per regulatory guidelines is approximately 160 gpm. The hydraulics of the high-flow pump were modeled and a pump was selected, based on the hydraulic characteristics of the piping system and the required flow rate, determined in the leachate system hydraulics analysis (Section 5.9.2.1). An EPG model WSD 30-3 (or equal) with a 7.5-horsepower motor was selected for the LCRS high-flow pump.

6.4.3.2 LDS Pump

The third submersible pump will be installed within each cell in the LDS sump, under the primary liner and above the secondary liner. This pump will detect and recover leachate that has leaked through the primary liner by pumping the leachate to the crest pad building. This pump was sized for low leachate generation flows.

The hydraulics of the LDS pump were modeled and a pump was selected that can produce 4 gpm, based on the hydraulic characteristics of the piping system and the required flow rate, identified in the leachate system hydraulics analysis (Section 5.9.2.1). An EPG model 1.5-3 (or equal) with a 0.5-horsepower motor was selected for the LDS pump.

6.4.3.3 Crest Pad Building Sump Pump

The sump pump within the crest pad building will be a submersible floor sump, activated by float switches within the floor sump. The function of the sump pump is to remove leachate that accumulates in the crest pad building as a result of unexpected spills or pipe leaks. The pump discharges water to the leachate storage tank via the crest pad building discharge piping.

The hydraulics of the sump pump were modeled and a pump was specified, based on the hydraulic characteristics of the piping system and the required flow rate identified in the leachate system hydraulics analysis (Section 5.9.2.1).

6.4.3.4 Leachate Transfer Pump

The leachate storage tank will be drained by using the leachate transfer pump, located in the leachate transfer building. The pump was sized to deliver a capacity of 250 gpm to the truck loading station, where it will discharge into a tanker truck. The typical volume allowed in a tanker truck is 7,000 gallons, corresponding to a loading time of approximately 30 minutes.

The hydraulics of the leachate transfer pump were modeled and a pump was selected, based on the hydraulic characteristics of the piping system and the required flow rate, identified in the leachate system hydraulics analysis (Section 5.9.2.1). A standard horizontal centrifugal pump, Paco model 30707 (or equal) with a 3-horsepower motor was selected for the leachate transfer pump.

6.4.3.5 Combined Sump Pump

The combined sump will be a 76-inch-diameter HDPE manhole with a 42 inch diameter HDPE manhole placed inside. The outer manhole will have a height of approximately 8 feet, and the inner manhole height will be approximately 6 feet. The secondary containment portion of all the buried HDPE pipelines, leachate tank, and leachate transfer building floor sump will drain to the annular space (leak detection chamber) between the two manholes. The leak detection chamber will include instrumentation to detect leachate and alarm accordingly. The sumps installed within the truck loading slab typically will collect precipitation that drains off the slab. The precipitation will be conveyed directly to the inner manhole of the combined sump, where the combined sump pump will be located. The combined sump pump then will pump the precipitation to the leachate storage tank.

The combined sump pump was conservatively sized for a capacity of 250 gpm. This large capacity was chosen based on an off-normal event that assumed the tanker truck was overtopped during leachate transfer activities, resulting in 250 gpm flowing into the inner sump. Another off-normal event considered was the remote possibility that the leachate tank primary liner failed catastrophically. This flow of leachate could eventually inundate the leak detection chamber and overflow into the inner manhole.

The hydraulics of the combined sump pump were modeled and a pump was selected based on the hydraulic characteristics of the piping system and the required flow rate, identified in the leachate system hydraulics analysis (Section 5.9.2.1). A Hydromatic model SB3S (or equal) with a 3-horsepower motor was selected for the combined sump pump.

6.4.4 Leachate Temporary Storage Tank

6.4.4.1 Tank Volume

A leachate temporary storage tank is required for each cell. The working capacity of each tank is 375,000 gallons that include a 1.5 safety factor. This volume is based on the results of the leachate production analysis (Section 5.8.1) and the leachate collection storage analyses (Section 5.9.2.4). The storage tank capacity is dependent on the net volume of leachate accumulation in the tank from flow into and out of the tank. The flow out of the tank via the leachate transfer pump is based on several assumptions, described in Section 5.9.2.4. Actual leachate transfer operations will affect the tank volume safety factor.

6.4.4.2 Tank Design

A bolted, corrugated steel tank, approximately 100 feet in diameter with a side wall height of 8 feet 2 inches, was selected for use as the leachate temporary storage tank. The tank will include a dual containment liner system that will act as the floor of the tank and will be bolted to the top of the tank side wall. The tank will be open-topped with a floating geomembrane cover to keep precipitation, debris, and wildlife from contacting the leachate.

The tank side wall will be bolted to a 1.5-foot thick, 4-foot-deep concrete ringwall to resist hydrostatic pressure of the leachate water. In addition, the top edge of the tank ringwall will include angle bracing; bolted around the tank perimeter to provide rigidity in the side wall to resist wind loads on the exterior of the tank. The maximum operating level of the tank is approximately 6 feet 2 inches; however, the tank is designed for a maximum water level of 8 feet 2 inches.

The inlet piping for the tank will be through the side wall of the tank. The inlets will all be located near the top of the tank, above the maximum leachate water operating level. This is to ensure that a siphon cannot develop in the inlet piping. Check valves will be installed throughout the system; however, if piping between the check valve and the tank leaked into the secondary containment system, there would not be an easy method of stopping the flow if the pipe was below the water surface of the tank.

The outlet pipe for the tank will be through the side wall, near the bottom of the tank. This method was chosen to provide a flooded suction for the leachate transfer pump that will provide added protection against pump damage.

6.4.4.3 Tank Liners

The tank liners will be constructed with an XR-5 geomembrane. XR-5 is a proprietary geomembrane manufactured by Seaman Corporation. XR-5 is the preferred liner of several tank manufacturers due to its higher strength properties and lower thermal expansion coefficient, as compared to HDPE geomembrane. As such, it is more readily constructable in the tank configuration, and it does not expand and contract as much as HDPE, so its operating performance over the temperature range at Hanford should be improved. For the exposed condition at the IDF tanks, this is an important consideration. HDPE was considered for use as the tank liner system, but its high coefficient of expansion will not lend itself to the temperature extremes that the liner system will be subjected to and also it is not reinforced like the XR-5. The expansion and contraction of an HDPE liner exposed to the environment could put undue strain at the inlet and outlet connections as well as at the leak detection connection that could result in liner leakage.

Chemical compatibility of leachate with the liner system is also a consideration for liner material selection for the leachate storage tanks. As discussed in Section 5.6.3.1, compatibility testing on HDPE geomembrane was performed with synthetic leachate for the W-025 landfill with no evidence of geomembrane deterioration. With regard to leachate compatibility, XR-5 is comparable to HDPE in terms of compatibility with typical leachate constituents. The geomembrane manufacturer requires immersion testing for conclusive compatibility determination. Testing of this type has not been performed, but the manufacturer is confident that immersion testing results will be acceptable since XR-5 is generally comparable to HDPE. To address the issue of chemical and radiation resistance for XR-5 with anticipated leachate constituents, an immersion test program is included in the technical specifications for the tank liner. Details are provided in Section 13205 of the technical specifications. This immersion testing program requires the construction general contractor to submit tank liner sample coupons to the design engineer for immersion testing, as part of the construction submittal process and certification of the tank liner.

In addition, it should be noted that leachate compatibility is not as critical an issue for the tank system as compared to the landfill liner system. The leachate tank liner system will be subject to continuous monitoring through the tanks' LDS, as is the landfill liner system. The difference is that the tank liners will be subject to routine maintenance and inspection that will be developed around liner warranty, performance observation, and manufacturer's requirements. Operation and maintenance procedures for the tank will be established that require that the tanks be drained, sediment removed, and the liner inspected for holes and seam integrity. Since liner performance guarantees are required in the technical specifications for the tank manufacturer for three years following installation, it is likely that the inspection program would be initially set up around this time frame and gradually be increased over the life cycle of the tank. Replacement of the leachate tank liner system is anticipated periodically throughout the life cycle of the landfill.

The tank lining system is a double-lined system. The primary and secondary tank liners will include a LDS beneath the primary tank liner. The LDS consists of a HDPE drainage net with a geotextile material, laminated to the drainage net that cushions the XR-5 liner. A geotextile material will also be used between the secondary liner and the inside face of the tank shell to create a cushion for the XR-5 against the tank shell and tank shell bolt heads. The bolt heads are also recessed for further liner protection.

6.4.4.4 Tank Leak Containment System

The HDPE drainage net between the primary and secondary liner will allow leachate that leaks through the primary liner to drain to the center of the tank. At the center of the tank under the secondary liner will be a depression in the underlying granular backfill that will form a shallow sump. The leak detection pipe will connect to the secondary liner at this sump location and convey leaking leachate to the leak detection chamber of the combined sump.

The tank inlet and outlet penetrations will be areas susceptible to leaks as a result of penetrations through the primary liner. Additional robust methods for sealing these locations were added over and above the typical manufacturer recommendations in an effort to make sure that these will not be points of leakage.

6.4.5 Pump Controls and System Instrumentation

The process and instrumentation diagrams for Cell 1 and Cell 2 are shown on Drawing H-2-830854, sheets 1 through 4. Detailed information regarding the instrumentation and control system, equipment listing, instrument listing, and loop descriptions can be found in the technical specifications, Section 13401 (Process Instrumentation and Control System).

6.4.5.1 Crest Pad Building

The leachate pumps within the landfill will be automatically controlled, based on leachate level setpoints within the cell sump. The level transducer that controls the LCRS pumps will be inserted into the sump via a slope riser pipe. The level transducer that controls the LDS pump is integral to the LDS pump. Leachate pumped by the leachate pumps will be monitored by a flow-indicating totalizer within the crest pad building. Controls will be in place to automatically stop the leachate pumps operation if alarm conditions are present for the leachate storage tank high-high level, leak alarm in the crest pad building sump, or a leak alarm in the combined sump.

The crest pad building sump pump will be automatically controlled by float switches within the building floor sump. In addition, a leak detection switch will be installed in the floor sump that will be capable of detecting small quantities of water in the sump before the float switches. This feature will add an extra level of conservatism to make sure unexpected spills are identified and controlled immediately. Controls will be in place to automatically stop the crest pad building sump pump operation if alarm conditions are present for the leachate storage tank high-high level or for a leak alarm in the combined sump.

6.4.5.2 Leachate Transfer Building

The leachate transfer pump will be manually controlled except for automatic shut-off during specific alarm events. Controls will be in place to automatically stop the transfer pump operation if alarm conditions are present for the leachate storage tank low-low level or for leak alarm in the combined sump. Additional instrumentation (associated with the leachate transfer pump) will include a flow meter (measuring rate and total volume) and transmitter on the discharge of the leachate transfer pump. In addition, a local totalizer will be in the leachate transfer building to know exactly how much water is being transferred to the tanker truck. This totalizer will include a reset function to allow the total to be reset to zero, prior to every truck loading event.

6.4.5.3 Leachate Storage Tank

Instrumentation within the leachate storage tank will be contained within two vertical stilling wells that will penetrate through openings in the floating cover. The stilling wells will be small diameter pipe with perforations near the bottom that will allow the leachate within the stilling well to rise and fall with the level of the leachate in the tank. Analog instrumentation within one stilling well will provide a signal to the control system for alarm interlocks and constant monitoring of tank level. The second stilling well will contain discrete instrumentation for high-high and low-low alarm setpoint trips. The discrete instrumentation will provide conservatism in the off chance that the analog signal malfunctions, allowing the leachate level to reach extreme high or low levels.

6.4.5.4 Combined Sump

The combined sump pump will be automatically controlled by float switches within the inner manhole of the combined sump. Controls will also be in place to automatically stop the combined sump pump operation if alarm conditions are present for the leachate storage tank high-high level. A leak detection switch also will be installed within the leak detection chamber that will be capable of detecting a small quantity of water. The leak detection switch will provide a signal to the control system that automatically will shut down all the cell pumps except the combined sump pump. The pumps will be shut down because any one of the pipelines associated with the pumps could be leaking into the leak detection chamber. Operations will then need to determine which secondary containment pipeline supplied the water that drained into the leak detection chamber.

6.4.6 Process Instrument Control System (PICS)

6.4.6.1 Introduction

This section provides a summary of the PICS design and construction elements of the project, providing introduction and reference to the project layout and key design components for the following IDF facilities:

- IDF leachate collection and handling crest pad facilities (two each)

- IDF leachate storage tank and leachate transfer facilities (two each)
- IDF truck loading facilities (two each)

The PICS design identifies, specifies and integrates PICS components to automatically monitor and control IDF process control equipment and facilities including:

- LCRS
- LDS
- Crest pad and leachate transfer building environmental controls
- Leachate storage tank system
- Leachate transfer and truck loading system
- Combined sump system
- Secondary containment LDS

6.4.6.2 Key Design Components (Elements)

PICS design and construction elements of the project incorporate the following key PICS design components for each IDF facility:

- Instrumentation for continuous analog process monitoring
- Instrumentation for discrete process monitoring
- Instruments and programmed safety interlocks and alarming
- Programmable logic controller (PLC) system
- Operator Interface Unit (OIU)
- Communication Local Area Network (LAN)
- PICS application software
- Main and local control panels
- Uninterruptible power supply

6.4.6.3 Open Items

The IDF Phase I Critical Systems design documents do not identify the following items:

- Identification of communication LAN from IDF control panels to central supervisory control and data acquisition (SCADA)
- Extension of communication LAN from IDF control panels to central SCADA.

These items are scheduled to be addressed during the IDF Phase I Non-Critical design of the project. As such, the following assumptions were made in order to complete IDF Phase I Critical Systems design:

- Assume 10/100 megabits per second (MBPS) Ethernet communication LAN from IDF control panels to central SCADA
- Assume fiber-optic multi-mode extension of communication LAN from IDF control panels to central SCADA

6.4.6.4 PICS Architectures

The PICS design identifies various architectures, designed to enable operators to locally and remotely interface and change program settings by the use of an Ethernet LAN. This document does not identify components and architectures to be provided and configured under the IDF Phase I Non-Critical design in order for personnel remote monitor and control processes over the LAN.

6.4.6.5 PICS Instrumentation Architecture

The PICS design identifies instrumentation architecture that consists of single variable level (submersible pressure), flow, and temperature elements and transmitters that provide continuous process data to PICS PLC and OIU architectures. Process signals from each instrument are monitored for the purpose of controlling, displaying, recording, and alarming all process data. PICS instrumentation will be wired directly into PLC input modules (i.e., Allen-Bradley 1746 I/O modules).

6.4.6.6 Instrumentation

The PICS design identifies all set-point adjustments as being programmed into the PLC via the OIU architecture. Field instruments incorporate the following signal types:

- Analog signals, current type: 4-20 mA dc signals conforming to ISA S50.1.1
- Transmitters type: 2-wire and 4-wire
- Transmitter load resistance capacity: Class L
- Fully isolated transmitters and receivers
- Discrete signals, voltage type: 24 VDC

6.4.6.7 Analog Instrumentation

The PICS design identifies flow analog instrumentation, consisting of electromagnetic flow elements and integral transmitters that will enable operators to monitor pump discharge flow for the following processes:

- Landfill LCRS pump discharge flow
- Landfill LDS pump discharge flow
- Leachate transfer truck loading station discharge flow

The PICS design identifies level analog instrumentation, consisting of submersible pressure transmitters that will enable operators to monitor liquid levels for the following:

- Landfill LCRS
- Landfill LDS
- Leachate storage tank system

The PICS design identifies temperature analog instrumentation, consisting of an element and transmitter that will enable operators to monitor temperature levels inside the following:

- Crest pad buildings
- Leachate transfer buildings

6.4.6.8 Discrete Instrumentation

The PICS design identifies level instrumentation, consisting of radio frequency (RF) admittance probes and transmitters that will enable operators to monitor discrete liquid levels inside the leachate storage tank system. The PICS design identifies level discrete instrumentation, consisting of magnetic float switches that will enable operators to monitor discrete liquid levels inside the following:

- Crest pad building sump
- Combine sump
- Combine sump interstitial

The PICS design identifies operator instrumentation, consisting of switches, indicating lights, and control relays that will enable operators to monitor the following discrete status:

- Crest pad building and control power status
- Landfill LCRS pumps ON/OFF, AUTO and FAIL status
- Landfill LDS pumps (on/off, auto, and fail) status
- Combined process sump pump (on/off, auto, and fail) status
- Leachate transfer pump (on/off, auto, and fail) status

6.4.6.9 PICS Programmable Logic Controller (PLC) Architecture

The PICS design identifies PLC architecture designed around Allen Bradley Ethernet small logic control technologies. PLC architecture consists of the following:

- PLC processor
- PLC input/output (I/O) modules
- PLC ancillary power supplies, chassis and cabling
- PLC application and development software and hardware

The PLC processor is the microprocessor-based device that uses programmable ladder logic for the purpose of implementing process monitoring and control, emulating the functions of conventional panel-mounted equipment such as relays, timers, counters, current switches, calculation modules, Proportional, Integral and Derivative controllers, stepping switches, and drum programmers.

PLC(s) are programmed to interface with instrumentation and process motor control equipment. PICS PLC(s) are programmed to automatically operate (start/stop) all process control equipment as well as process flow totals, equipment runtime, operation alarms, equipment, and building status.

Instrument architecture (analog and discrete control devices) interface with PLC via PLC I/O modules, installed in a common chassis with the PLC power supply.

The type of I/O modules utilized include analog (4-20 mA) input, 24VDC discrete input, and 120VAC/ 24VDC discrete output.

The PICS design identifies PLC application software that provides functions unique to the project and not provided by PLC system software alone, such as programmable controller ladder logic, math operations on input process variables (scaling, alarming, totalizing, comparisons).

The PICS design identifies PLC standard system software packages that enable personnel to communicate and program PLC processor and configure I/O modules. PLC development and application software reside on the programming laptop from which the application is downloaded into the PLC processor.

The PICS design identifies communication protocols establishing data exchange between PLC, programming laptop, OIU architecture, and future remote SCADA as follows:

- Allen Bradley RS-232, RS-4585, and DF1
- Ethernet

6.4.6.10 PICS Operator Interface (OIU) Architecture

The PICS design identifies OIU architecture that allows operators to visually monitor process system data and interface with the facility's programmable logic controllers. OIU enables operators to view alarms and change process set points.

PICS OIU architecture is designed around Allen Bradley PanelView, communicating with PLC architecture over a communication local area network. OIU architecture includes:

- OIU assembly
- Local area network copper cabling
- OIU application and standard system software

The PICS design identifies OIU application software that provides functions unique to the project and not provided by system software alone. These include, but are not limited to, programmable controller ladder logic, databases, reports, control strategies, graphical display screens, and operation scripts.

The PICS design identifies OIU standard system software packages that enable personnel to communicate and program OIU. OIU application and standard system software reside on the programming laptop from which the application is downloaded into the OIU processor.

6.4.6.11 PICS Communication LAN Architecture

The PICS design identifies communication between PLC processors, OIU, programming laptop, and future IDF SCADA over a local area network consisting of a local 10/100 MBPS Ethernet switch, local PLC, OIU LAN drivers, and a cable system. The PLC processor and OIU are addressable over the LAN, allowing each device to share data and control points between each other and future devices.

6.4.6.12 Back Up Power

The PICS design identifies UPS mounted inside each main control panel. UPS(s) was sized so as to enable PLC and OIU networks to maintain monitoring of process control systems during a power failure as well as provide for an orderly shutdown. UPS does NOT power process control equipment such as solenoids, instruments, motorized valves, pumps, and motors.

6.4.6.13 Control Panels

The PICS design identifies the main control panel, mounted inside each crest pad building housing PLC processor and associated I/O modules, ancillary power supplies, termination devices, UPS, and control circuit protection devices. OIU and process flow and level indicators are mounted on front doors of control panels.

The PICS design identifies local control panels, integrating discrete level instrumentation, control relays, intrinsic safety relays, and providing interlock signals between PLC architecture and MCC pump controls.

6.5 STORMWATER MANAGEMENT

The proposed stormwater system to be constructed just south of the south end of the Phase I excavation will intercept stormwater runoff from the area to the south for the 24-hour, 25-year storm event so that it will not flow into the Phase I excavation and will discharge the intercepted stormwater into the ground via infiltration. This system will consist of the south stormwater berm/ditch, two culverts, and the east and west infiltration areas. The berm will be two feet high above the existing ground surface. The minimum combined depth of the berm and ditch will be two feet. The ditch will be V-shaped with 3:1 side slopes. The culverts will be 18-inch-diameter, corrugated polyethylene pipe with smooth interior. Geotextile and quarry spalls will be placed around each end of the culverts to provide erosion protection. The east and west infiltration areas will have bottom lengths of 220 and 225 feet, respectively. Each of the infiltration areas will have a bottom elevation of 719 feet and a bottom width of 15 feet. In order to allow access for future maintenance into each of these infiltration areas, their north and south ends will be sloped at 15 percent and surfaced with quarry spalls placed on a geotextile.

The proposed stormwater system to be constructed at the south toe of slope within the Phase I excavation will intercept stormwater runoff from the unlined portions of the excavation for the 24-hour, 25-year storm event so that it will not flow into the active cells and will discharge the intercepted stormwater into the ground via infiltration. This system will consist of the excavation stormwater berm/ditch, a stormwater pipe, one catch basin, and the excavation infiltration area. There also will be a flow path along the south side of the access ramp that will continue along the south side of the flat area at the base of the access ramp and into the southwest corner of the excavation infiltration area. The south stormwater berm/ditch will slope to drain to the east. The combined depth of the berm and ditch will be two feet. The stormwater berm will be 2 feet high at its west end, and the corresponding depth of the ditch will be zero. The berm will gradually reduce in height as the depth of the ditch increases. The berm will end when the ditch depth reaches 2 feet. The ditch will be V-shaped with 3:1 side slope on the south and 2:1 side slope on the north. The stormwater pipe will be 18-inch-diameter corrugated polyethylene pipe with smooth interior. Geotextile and quarry spalls will be placed around each exposed end of the stormwater pipe to provide erosion protection. The catch basin will be used to lower the elevation of the stormwater pipe so that there will be adequate cover over the pipe for protection against wheel loads. The infiltration area will have a bottom elevation of 678 feet, a bottom width of 15 feet, and a bottom length of 50 feet. In order to allow access for future maintenance into this infiltration area, the west end will be sloped at 15 percent and surfaced with quarry spalls placed on a geotextile.

If the water builds up in the east or west infiltration area, it will eventually flow out of the north end of the infiltration area. The water would flow overland, north along the toe of the fill for the berm access road, and continue generally northward.

If the water builds up in the excavation infiltration area so that it extends into the ditch, then the operator will have to bring in a portable pump and pump the water into the east infiltration area.

Maintenance for each of the infiltration areas, the ditches, and the ends of each of the culverts and stormwater pipes will be primarily to remove accumulated sediment and debris.

6.6 BUILDING SYSTEMS

6.6.1 Crest Pad Buildings

The crest pad building is designed as a pre-engineered, rigid frame metal building on a slab-on grade foundation. The building slab is separated into two portions. The lower portion of the slab is where the piping associated with the leachate pipe will be contained, and the higher slab is where the electrical and control equipment will be located. The slab where the leachate piping will be located is lowered to create a containment area for the leachate. Construction joints within this area have waterstops to ensure that leachate cannot egress through the construction joints. Additionally, a sump has been placed to drain the containment area, if required. The entire floor and sump area also is to be coated to provide even greater resistance to the leachate.

6.6.2 Leachate Transfer Buildings

The leachate transfer building is designed as a pre-engineered, self framing metal building on a slab-on-grade foundation. The metal building is supported on an 8-inch curb that travels continuously around the exterior of the building. The curb is continuous, even through the door threshold, to provide a containment area for the leachate in case of spillage. In order to maintain conformance with building code requirements, a landing is used to eliminate the curb tripping hazard at the door threshold. Construction joints within this area have waterstops to ensure that leachate cannot egress through the construction joints. Additionally, a sump has been placed to drain the containment area, if required. The entire floor and sump area also is to be coated to provide even greater resistance to the leachate.

6.6.3 Truck Loading Station

The truck loading station is designed to receive trucks to load with leachate. The station is essentially a slab-on-grade. The station is designed to contain minor spillage of leachate by sloping the floor slab towards the center and using rounded curbs at the slab entrance and exits. Two sumps will be placed in the center of the station to drain the station as required. The entire floor and sump area also is to be coated to provide even greater resistance to the leachate.

6.7 ELECTRICAL SERVICE AND LIGHTING

6.7.1 Introduction

This section provides a summary of the electrical design and construction elements of the project, providing introduction and reference to the project layout and key design components for the following IDF facilities:

- IDF leachate collection and handling crest pad facilities (two each)
- IDF leachate storage tank and leachate transfer facilities (two each)
- IDF truck loading facilities (two each)

The electrical design identifies, specifies, and integrates power distribution systems that incorporate transformers, breaker panels, motor control, safety switches, conductors, and lighting for the safe, reliable, and maintainable operation of IDF process and facility equipment including:

- Process equipment (leachate collection and removal pump motors, leak detection pump motors, transfer pump motors, and instrumentation)
- Building facility equipment (lighting, power outlets, heating units, cooling fans, and building sump pumps)
- Personnel and equipment safety systems (standby egress lighting, process alarm lighting, surge protection, and process piping heat trace)
- Electrical design and installation shall be in accordance with NFPA 70 (NEC, 2002)

6.7.2 Key Design Components (Elements)

Key electrical design components (elements) for each IDF facility include:

- Electrical secondary service and monitoring
- Electrical secondary service and feeder protective device coordination
- Electrical secondary service ground electrode system
- Electrical service, equipment, and associated metal structures grounding
- Electrical low voltage motor control
- Facility maintenance outlets (standard, ground fault circuit interrupter [GFCI], weatherproof)
- Facility interior, exterior, and egress safety lighting
- Facility environmental control (heating and cooling)
- Facility hazardous classification
- Process equipment heat trace, ambient monitoring, and power indication
- Facility electrical system surge and phase protection
- Materials and methods of electrical construction (i.e., conduit, wire, control and safety device, and enclosure selection)

6.7.3 Open Items

IDF Phase I Critical System design documents do not identify the following primary and secondary electrical service items:

- Exact location of primary 13.8 kV, 3-phase tie-in
- Exact value of available primary short circuit current at primary tie-in location
- Exact length of primary extension
- Exact location, size, and impedance of utility step-down 13.8 kV – 480/277V, 3-phase, 4-wire pad mounted transformer(s)

6.7.4 Assumptions to Open Items

These items are scheduled to be addressed during the IDF Phase I Non-Critical design. As such, the following assumptions were made in order to complete the Phase I design:

- Assume electrical service gear inside each Cell 1 and Cell 2 crest pad building are powered by separate pad mounted utility transformers.
- Assume pad mounted utility transformers are rated 75 kVA and are installed within 100 feet of respective Cell 1 and Cell 2 crest pad buildings.
- Assume each pad mounted utility transformer is radial fed from a common 13.8 kV primary feeder.
- Assume each Cell 1 and Cell 2 leachate transfer building is powered from electrical service gear, located inside respective crest pad buildings.
- Assume utility short-circuit contribution to be 100 MVA at 13.8 kV, three-phase.

6.7.5 Crest Pad Building Electrical Secondary Service and Metering

Electrical design identified 480 volt, 3-phase, 4-wire secondary service cables eventually powering a service-rated MCC mounted inside each crest pad building.

Type	Designation	Configuration
Cell 1 Service rated MCC	219A-LH-MCC-001	480V, 3-ϕ, 3-wire, 4-wire
Cell 2 Service rated MCC	219E-LH-MCC-001	480V, 3-ϕ, 3-wire, 4-wire

The service-rated MCC will operate as a main service gear, power distribution center, and motor control assembly. A MCC distributes 480 volt, 3-phase power to the following 3-phase equipment:

- LCRS three-phase pump motors
- LDS three-phase pump motor
- Combine sump three-phase pump motor

- Crest pad building and leachate transfer building unit heaters
- Crest pad and leachate transfer lighting panel transformers

Secondary 3-phase power is monitored by phase loss and phase reversal protection relays mounted inside MCC(s). In the event of a phase loss or phase reversal condition, the protection relay will shunt the MCC main service breaker. With main service breaker shunted (open), a UPS mounted inside each PICS main control panel will continue the operation of voltage sensitive PICS equipment (i.e., PLC, OIU, local area network communication), allowing for future remote alarming (future SCADA) and the safe shutdown of sensitive equipment.

Incoming power is also monitored through the use of analog-style voltage and current meters. Operators will be able to observe operating status of incoming power by manually selecting analog-style voltage and current meters to Phase A, Phase B, and Phase C.

MCC associated gear (frame, bussing, and feeder protective devices) were sized to adequately and safely handle the calculated design and demand operating loads, and to safely withstand calculated short circuit interrupting currents.

6.7.6 Utilization Voltages

The electrical design identified utilization voltages for the following equipment and systems:

Equipment or System	Voltage, Phase
Lighting	120 V, 1-ϕ
Heat trace	120 V, 1-ϕ
Convenience outlets	120 V, 1-ϕ
Instrumentation control circuits	24 V DC
Motor control	120 V, 1-ϕ
Air conditioner	208 V, 1-ϕ
Motors, less than 1/3 hp	120 V, 1-ϕ
Motors, 1/3 hp and larger	480 V, 3-ϕ
Unit heaters	480 V, 3-ϕ
Instrument power	120V, 1-ϕ

6.7.7 Leachate Transfer Building Electrical Service

The electrical design identified three phase motor loads inside leachate transfer buildings as being powered from MCC, located inside each crest pad building. Power will be routed from MCC to service-rated disconnect, wire-way, enclosed breaker, and mini-power center (panel/transformer assembly), located inside each leachate transfer building.

Type	Designation	Configuration
Cell 1 service-rated disconnect	219A1-LH-SW-002	480V, 3-ϕ, 3-wire, 4-wire
Cell 2 service-rated disconnect	219E1-LH-SW-002	480V, 3-ϕ, 3-wire, 4-wire

6.7.8 Crest Pad and Leachate Transfer Building Lighting Panelboards

The electrical design identified lighting panel boards installed in each IDF facility to provide 120/208V 3-ϕ, 4-wire power to non-three-phase motor loads. Lighting panelboards will be fed from 480V- 120/208V 3-ϕ, 4-wire step-down transformers. Lighting panelboards inside crest pad buildings will be mounted along with step-down transformers inside MCC. Lighting panelboards (mini-power centers, along with integral step-down transformers) inside leachate transfer buildings will be wall mounted.

Type	Designation	Configuration
Cell 1 crest pad building lighting panel	219A- LH-LP-001	120/208V, 3-ϕ, 4-wire
Cell 1 crest pad building lighting panel	219E- LH-LP-001	120/208V, 3-ϕ, 4-wire

Cell 1 leachate transfer building lighting panel	219A1- LH-LP-002	120/208V, 3-ϕ, 4-wire
Cell 2 leachate transfer building lighting panel	219E1- LH-LP-002	120/208V, 3-ϕ, 4-wire

Lighting distribution panelboards will provide 120 volt power to all single-phase equipment including:

- Building lighting
- Emergency lighting
- Receptacles
- Main control panel

Instrumentation will be powered from surge-protected circuit breakers inside each crest pad building main control panel.

Lighting distribution panelboards will provide 120/208 volt, single and three-phase power to equipment including the building air conditioner, and heat tracing for process piping.

6.7.9 Feeder and Branch Circuits

The electrical design identified feeder and branch circuit breakers and conductor's size, based upon connected and operating loads. Style of feeder and branch circuit breakers will be thermal-magnetic.

6.7.10 Raceways

480V power circuits–Standard rigid galvanized steel (RGS) in exposed locations, PVC conduit systems will be buried, RGS will be coated when conduits transition from below grade to above grade areas

120V power circuits–Standard RGS in exposed locations, PVC conduit systems buried, RGS coated when conduits transition from below grade to above grade areas.

6.7.11 Raceway Sizing, Selection, and Installation Guidelines

The electrical design identified conduit wire fill and size, based upon THW (thermoplastic, vinyl insulated building wire; flame retardant, moisture and heat resistant, 75°C, dry and wet locations) insulated conductors for wiring 600 volts and below. Minimum raceway sizes will be as follows in the designated locations:

Minimum Raceway Size:	Location:
3/4-inch	Exposed on walls and ceiling
3/4-inch	Concealed in frame construction and finished ceilings
1-inch	Underground for circuits below 600 volts, including instrumentation
3-inch	Fiber optic

The electrical design identified underground raceways assemblies as concrete ductbank constructed.

6.7.12 Wire and Cable

The electrical design identified stranded copper conductors that will be used for all wiring, except for lighting and receptacle circuits where solid copper will be used. Minimum conductor size of No. 12 will be used for power and lighting branch circuits. **Conductors installed in all branch circuits rated 100 amps or less were sized based upon NEC table for 60°C TW conductors.**

- No. 12 AWG copper for lighting and receptacle branch circuits
- No. 10 AWG, minimum, wiring for all outdoor power circuits
- No. 14 AWG, minimum, for all instrumentation 24VDC discrete control and instrument power
- No. 16 AWG, minimum, shielded for all instrumentation 24VDC analog control

6.7.13 Convenience Receptacles

The electrical design identified weatherproof 20 amp duplex receptacles for indoor service, weatherproof GFCI 20 amp duplex receptacles for outdoor service.

6.7.14 Motor Control

The electrical design identified full voltage non-reversing (FVNR) combination motor starter assemblies, to be mounted inside MCC for each constant speed motor. FVNR combination motor starter assemblies will consist of thermal-magnetic, trip-molded case circuit breakers; full voltage combination starters; control power transformers; indicating lights; and control switches. All combination motor starters will be operated in AUTO mode by PICS.

6.7.15 Overload Protection

The electrical design identified each motor as being provided with thermal overload protection in all ungrounded phases. Each controller will be provided with overload heaters and controller-mounted relays with external manual reset.

6.7.16 Grounding

The electrical design identified the grounding electrode system for each IDF facility, integrating ground ring rods, and connection to building rebar. The electrical design identified electrical service neutral, and the neutrals of derived sources, electrical equipment, and PICS control panels that will be bonded to grounding electrode systems.

6.7.17 Equipment Grounding

The electrical design identified noncurrent-carrying parts of all electrical equipment, devices, panelboards, and metallic raceways that will be bonded to grounding system.

The electrical design identified noncurrent-carrying parts of all mechanical equipment, to which electrical components will be attached and may potentially become energized, that also will be bonded to the grounding system, including building metal structures and leachate storage tank.

All conduits that will be provided have an equipment grounding conductor.

6.7.18 Lighting

The electrical design identified lighting fixtures that will be installed at each IDF facility to maintain an average 25-foot candle inside each building, and 5-foot candles at entrance doorways.

Note: *Interior lighting levels are based upon* *__IES Lighting Handbook Indoor Industrial Areas Recommended Illuminance Levels__* *for interior activities inside work spaces where visual tasks of medium to large contrast are to be performed on occasional basis.*

Note: *Exterior entrance lighting levels are based upon* *__IES Lighting Handbook Outdoor Site/Area Recommended Illuminance Levels__* *for building exterior entrances frequently visited locations.*

6.7.19 Emergency Lighting System

The electrical design identified emergency illumination (battery-pack wall-mounted units or luminaries powered by integral battery-powered ballasts) that will be provided in all IDF facilities.

6.7.20 Circuiting and Switching

The electrical design identified interior process area lighting, switched to provide adequate lighting. Exterior building lighting will be controlled by photocells.

6.7.21 Heat Trace

The electrical design identified electrical heat trace for above grade process piping freeze protection. Heat trace cable will be the self-limiting type with the overall system controlled by an ambient control thermostat. Heat trace design incorporates circuit power indication.

6.7.22 Hazardous Classification

The electrical design identified the interior of the combined sump as Class 1, Division 2 group, C hazardous. The electrical design for the combined sump will incorporate materials and intrinsic safety devices compatible for the installation of electrical equipment in Class 1, Division 2, Group C hazardous locations.

6.8 CONSTRUCTION QA REQUIREMENTS

The Construction QA Plan describes the QA activities for constructing the Phase I IDF. QA activities will be required during construction to ensure the following:

- Firm and stable foundation system for liners
- Stability of dikes or embankments
- Low permeability soil liners that inhibit contaminant migration
- Geosynthetic layers that function as either a hydraulic barrier or a drainage system, depending on intended function
- LCRS and LDS that remove leachate and control head on the lining systems

The Construction QA Plan has been prepared to describe the activities that will be performed during construction of the lining system, leachate collection system, and operation layer of Cell 1 and Cell 2. The Construction QA Plan satisfies the regulatory requirements and guidance established in

40 CFR 264.19, the EPA technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993), and WAC 173-303-335.

The specific physical components that the WAC requires the Construction QA Plan to address include:

- Foundations
- Dikes
- Low-permeability soil liners
- Geomembranes
- LCRS and LDS
- Final cover systems

The WAC requires the Construction QA Plan to include the following:

- Identification of applicable units and how they will be constructed
- Identification of key personnel
- Description of inspection and sampling activities

The Construction QA Plan is intended to be implemented by an independent, qualified Construction QA certifying engineer, familiar with EPA's technical guidance document, *Quality Assurance and Quality Control for Waste Containment Facilities,* as well as the Construction QA Plan. The Construction QA certifying engineer will be supported by other Construction QA representatives, as necessary, to implement the requirements in the Construction QA Plan and document the work.

The Construction QA Plan establishes general administrative and documentation procedures that will be applicable for selected activities of construction. The Construction QA Plan addresses only those activities associated with the soils, geosynthetics, and related liner and leachate collection system piping components for the Phase I IDF landfill. Other aspects of construction, such as transmission piping, utilities, concrete, and storage tanks, also will require QA testing and oversight. These requirements are not mentioned in the Construction QA Plan, but they will be included in future construction inspection documents, accompanying the bid-ready drawings and specifications.

6.9 INTERFACE WITH NON-CRITICAL SYSTEMS

Critical systems for the Phase I IDF include three primary design components:

- Liner systems
- LCRS
- LDS

In addition, the Phase I IDF detailed design also involves completing all design work required for an operable landfill.

Non-critical systems for the Phase I IDF include the following components:

- Entrance facilities, including entrance area, scales, and staging areas
- Administration and control facilities
- Waste delivery access road improvements to the IDF site from the WTP
- Waste treatment and staging areas
- Gates and fences
- Utilities including fire protection, process water, electrical power, or instrumentation cables

The IDF Phase I Critical Systems design has been prepared to interface with these non-critical systems that are necessary for operational readiness for the IDF. The following discussion details interface elements of the current design with these non-critical systems.

There is the potential for the DOE to procure an independent contractor to provide operation and maintenance services for the IDF. These services could also include the detailed design and construction of a portion or all of the non-critical systems for the facility. If this should be the case, careful consideration will be given to these interface elements in the development of performance criteria that will be included as part of any contract package for these services.

6.9.1 Entrance Facilities

Entrance facilities will control the flow of waste into the IDF. These facilities will provide for waste delivery, inspection, check-in, and final authorization for disposal into the IDF. Typically, the location for the entrance facilities is adjacent to the in-bound access road, prior to reaching the disposal area. Other factors that can influence their location include access to existing utilities and other operational facilities such as waste treatment, soil stockpiles, or staging areas. Based on the current configuration planned for the IDF, there will be room for entrance facilities to the south of the Phase I disposal area, along the western access road. Typically, these facilities require connection to such utilities as fire protection, power, and process water. Utility interfaces are discussed later in this section.

Design criteria and detailed design elements for the IDF entrance facilities have not been developed. The overall mission for the facility has expanded from handling just the ILAW packages to other wastes including Waste fdrom the DBVS and LLW materials. This may require the entrance facilities to have expanded capabilities for waste load staging, inspection, verification, and scaling, prior to release for disposal into the IDF. This could impact the location selected for the entrance facilities, since complete development of the IDF to its full capacity will leave little room to the south of the southern perimeter berm for the facility (refer to Drawing H-2-830827). This could require the entrance facilities to be located along 1st Street, if a permanent initial location is desired. Otherwise, a more mobile entrance area could be developed and relocated along with phased development of the facility.

6.9.2 Administration and Control Facilities

Administration and control facilities will provide the control center for LCRS operations and monitoring, as well as monitoring for LDS and other emergency systems (fire, power interruption, and HVAC controls). The administration building will service facility operations, including waste tracking and record keeping systems as well as provide for staff needs including office facilities, lunch room, lockers, and storage. Other functions that may take place in this facility area include equipment maintenance, an equipment and staff decontamination area, and equipment storage.

The proposed location of the administration building is shown on Drawing H-2-830827, to the north of the leachate storage and handling area (north of the IDF Phase I development area). This location provides quick access to the leachate control buildings and storage tanks, as well as good interface with existing utilities that will come from existing facilities to the east and west of the IDF. Power and control/communications cables will connect the administration building to the leachate control buildings (crest pad buildings, leachate pump buildings, and leachate storage tanks), as well as to other leachate control structures including the combine manholes and truck loading stations for Cell 1 and Cell 2. Additional utilities will service the administration building including fire protection, process water, potable water, communications, and power.

Design criteria and detailed design need to be established for the administration building. The expanded mission of the IDF may influence existing criteria that have already been determined for this facility as provided in conceptual design documents for the original ILAW W-520 Project. Modular units may be considered for this facility.

6.9.3 Waste Delivery Access Road

The waste delivery from the WTP will access the IDF from 1st Street and enter the IDF along the western perimeter of the landfill. Waste delivery from other areas will access the facility from one of three gates (810, 812, or 815) to the 200 East Area, as discussed previously in Section 1 (refer to Figure 1-3).

The Phase I access road is aligned horizontally with the proposed western berm of the complete IDF landfill. The vertical alignment of Phase I access road coordinates with the existing topography of the site between 1st Street and the Phase I landfill area, to minimize cut and fill requirements for this road construction. As such, the Phase I vertical alignment does not follow the vertical alignment of the future western perimeter berm of the landfill and will need to be modified in future expansion phases. All-weather pavement for the Phase I road as well as for 1st Street will need to be completed as part of non-critical design. It is anticipated that pavement will be asphalt concrete pavement.

Access for waste haul vehicles will require upgrades to 1st Street to be designed as part of non-critical systems. Design criteria for this upgrade will be based on the anticipated haul vehicles and wheel loads for the various wastes to brought to the facility. From the Phase I Critical Systems design, the melter transport vehicle represents the most restrictive design condition for the road in terms of axle load and radius/grade limitations. However, there are also substantial wheel loads and larger volumes for ILAW package transport vehicles and other MLW and LLW wastes.

It should be noted that there will be a significant grade differential between the southern end of the IDF perimeter berm and the existing 1st Street road grade. The western berm climbs at a uniform 1 percent grade to the south. As such, it will have an elevation of approximately 741 feet at the southern perimeter road. The existing grade of 1st Street at the western perimeter of the IDF is approximately 734 feet, and so 1st Street will need to be raised to make this transition and keep vertical road grades at a maximum of 5 percent to accommodate the melter transport vehicles.

6.9.4 Waste Treatment and Staging

Currently, no waste treatment facilities have been planned for the IDF. Consideration of waste treatment may be necessary as part of the IDF's expanded mission to take mixed wastes and low-level wastes from both onsite and offsite sources, depending on the waste acceptance criteria that are established for the facility. Waste staging areas are associated with waste receipt and inspection activities, as mentioned previously. Staging and storage areas may also be needed for waste treatment as well. Design of non-critical facilities may need to consider development of these waste treatment and staging areas.

During Phase I operation, there is adequate area south of the Phase I landfill area for treatment and staging. Some staging also can occur within the landfill itself that offers the advantage of occurring over lined areas with leachate collection systems in place. However, as wastes are placed and cell lifts become full, staging areas may be limited until new lifts are ready for waste placement. Regulatory requirements for waste staging and storage may also impact location and operational requirements for these areas.

6.9.5 Gates and Fences

The IDF is being developed within the 200 East area of the Hanford Site, that has controlled access with a perimeter fence and access control gates (refer to Figure 1-1). As such, it is currently not anticipated that additional fencing and gates will be required for access control to the facility. However, operationally it may be determined that a perimeter fence and additional gates may be warranted for isolation of the IDF from adjacent existing facilities and, if so, these need to be designed during implementation of non-critical design components. Site standards for fences and gates would be followed for this design.

6.9.6 Site Utilities

As mentioned previously, site utilities are included in non-critical systems design. Site utilities will interface with existing utilities that service facilities in the 200 East area. As such, substantial coordination will be required to locate these utilities, determine the best interface tie-in location, and bring these to the IDF site. Key utilities that are needed for the IDF include:

- Power to buildings and operating systems, as well as to area lighting
- Communication between administration building and operating systems, as well as from the IDF to other area networks
- Fire protection water
- Process (non-potable) water for operations and facility construction
- Potable water

Power requirements for leachate control and monitoring systems have been designed during this Phase I Critical Systems design. Access vaults to power and control systems are provided outside of both crest pad buildings (shown on Drawing H-2-830858). It is anticipated that the administration building will connect at these access vaults and will provide power for system operation and an Ethernet connection for controls. Transformer design for bringing power from the site to the administration building (and to leachate control facilities) will be performed during non-critical design, as will design of the Ethernet connection and administration control systems.

Utility corridors need to be developed to bring these utilities to facility areas. It is recommended that these corridors be developed outside of landfill embankment areas and access roads, to allow for uninterrupted waste placement and facility operation, for future landfill phase development, for protection of liner system anchor trenches, and for protection of utilities from heavy wheel loads. In addition, the future final cover of the IDF is located over the perimeter embankments and catches existing ground at the outside toe of the embankment.

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7.0 OPERATING PROVISIONS

7.1 WASTE PLACEMENT

7.1.1 Introduction

To establish a baseline for design, construction, and operation of the IDF, a plan for filling the landfill cells was developed. This plan was developed mainly to ensure that landfill configuration and size as proposed for the IDF Phase I Critical Systems were adequate for safe placement of the ILAW, waste from the DBVS, and LLW, both remote handle and contact handle, that will be placed in the Phase I development. The proposed configuration and size of the IDF Phase I landfill are identified in Section 6 of this report.

The drawings that show the waste placement plan are included in Appendix D.1. This plan was based on the concept of completely filling the first lift in both cells before beginning filling of the succeeding lift. The plan represents one approach to filling the cells within the proposed configuration. It is possible that other approaches, such as proceeding to a subsequent lift before completely filling the previous lift, also are workable, but development of the plan did not consider alternative methodologies to fill the cells. Development of the plan is also based on conformance with the operational procedures identified for the Base Alternative in Appendix K of the *Conceptual Design Report for Immobilized Low-Activity Waste Disposal Facility, Project W-520* (RPP-7908, Revision 0), (CDR).

This waste placement plan is intended to meet the applicable functional criteria identified in the *System Specification for Immobilized Low-Activity Waste Disposal System* (RPP-7303, Revision 3). "As low as reasonably achievable" principals (keeping radiation exposures to as low as reasonably achievable) are embodied in the waste placement plan that was developed. Because of the area available for waste disposal in each cell, the plan provides the capability to relocate filling operations to another area within each cell, if an event occurs that causes operations to temporarily halt, placing waste packages at the current working position. This will allow waste package placement to continue while the situation that caused the operations to cease is resolved.

7.1.2 Phase I Configuration

Under the proposed configuration for the IDF Phase I, there will be two cells, identical in size. One cell will be for disposal of ILAW and waste from the DBVS; the other cell will be for disposal of LLW. This waste placement plan proposes disposal of ILAW and DBVS waste Cell 1 and disposal of LLW in Cell 2. Provisions are included for disposal of both remote handle and contact handle waste in each cell.

The configuration of the IDF Phase I development as it will exist at the completion of construction, prior to beginning filling operations, is shown in Appendix D, Drawing D.1-1. The initial operations layer, placed as part of Phase I construction, will cover the entire bottom liner and LCRS. The top of the operations layer will be level in the east-west direction and slope down at 1 percent from the south to the north. The operations layer will extend up the west, north, and east side slopes. Access to the facility will be from 1st Street along the western site boundary. An access ramp from the southwest corner of Phase I will lead down the south excavation slope from the west side to the bottom of Phase I and connect to the top of the operations layer near the south east corner of Cell 2.

7.1.3 Waste Receipts

As stated in Section 6.2, the IDF will receive ILAW and Waste from the DBVS. The volumes stated in Section 6.2 are based on waste forecast information provided by FH. The waste volume forecasts are updated by Hanford Site contractors on a regular basis. Actual waste receipt rates at the IDF will likely vary from the estimated amounts. Depending on the receipt rate of ILAW and DBVS waste versus the receipt rate of LLW, each lift of Cell 1 and Cell 2 may fill at different rates. The waste placement plan can accommodate differing rates of waste receipt because filling in subsequent lifts in each cell could be begun at different times as soon as the prior lift was complete. The cell that has the higher waste receipt rate will fill faster than the other cell and will determine the time when subsequent phases of development will need to begin so that additional disposal capacity is available when it is needed.

7.1.4 General Waste Placement Procedures

The discussion of waste placement in this plan is based on placement of the uniform height ILAW packages using remote handle. Some adjustments may need to be made for the variable height LLW containers and for contact handle waste, but in general the waste placement concept will be the same for all types of waste.

The configuration of IDF Phase I provides a height sufficient for four layers of ILAW packages, each covered with one meter of operations layer soil to provide shielding to operations personnel during waste package placement. LLW, which will be in variable height containers, can be accommodated within each of these four lifts. However, in some cases the LLW containers may exceed the lift height and, therefore, will not be completely covered by placement of the operations layer soil. In these cases, it may be necessary to mound cover soil around the individual projecting LLW containers to provide sufficient cover for shielding until they are completely covered by subsequent lifts.

Each lift will contain multiple ILAW package arrays that span the width of each cell. The packages will be placed in close-packet hexagonal arrays, with placement tolerance averaging 10 centimeters (4 inches) center to center. As the packages are placed in the cell, the array will proceed along the width of the cell. The earth cover will proceed shortly behind the advancing package array, the distance behind the front package limited by the repose slope of the fill soil. The array width (number of columns of packages) will be limited according to the amount of radiation generated by the total number of packages that can be exposed. The CDR indicates that even at some distance from the advancing array, the dose rate becomes a concern when the array approaches more than ten or twelve packages in width.

Off-loading of the ILAW packages and other waste containers will take place in the cell. A standard, manually operated, rubber-tired crane will off-load packages, move temporary shielding walls (concrete blocks), and place the interstitial fill between the packages using a hopper. In the CDR, the total weight of the shielding bell, package grapple, load cell, hooks, and other rigging is estimated at 20 metric tons (23 tons). The crane, as identified in the CDR, will be a Grove GMK 5100, a 108 metric ton (120 ton), rough terrain rubber-tired crane with a telescoping boom and a maximum reach of 15 meters (50 feet), with a load of 20 metric tons (23 tons). Pad loads could exceed 55 metric tons (60 tons) when placing an ILAW package at the maximum allowable reach. Dunnage required under each outrigger pad of the crane for lifts of this size has been determined to be 60 square feet, when operating directly on the base operations layer at its point of minimum thickness over the bottom liner system. Dunnage requirements for subsequent lifts would be less, but have not been determined. Refer to Section 5.5.5 and Appendix C.5.e of this Design Report for dunnage requirement calculations.

7.1.5 Moveable Shielding Wall

With off-loading operations in close proximity to the advancing package array, a moveable shielding wall will be set up between the crane and transporter operations and the placed packages (CDR, Drawing No. ES-W520-BASE). With the 15-meter (50-foot) maximum reach of the crane, the shield walls will have to be moved after every five rows of packages are placed. For a ten-package-wide-array, the wall will need to be relocated after fifty packages have been deposited, or about every eight days during Phase I.

To prevent the crane crew from receiving a high exposure rate, a new shield wall will be erected before the first shield wall is removed. A remote grappling system will be required to prevent rigging of the previously placed shield wall from causing high dose rates to operations personnel. Even then, the amount of time it will take to move the wall is estimated in the CDR to be 26 hours, four to five shifts, or a little less than two days when operating a full 24 hours per day.

An alternative to the movable shielding wall is to use contact handle waste to construct the shielding wall and to leave it in place after placement of each ILAW array rather than moving it. This can reduce operations labor and expenses. It can also result in the use of less cover soil because the space between the package arrays will be partly filled with contact handle waste, rather than with all soil. This alternative needs to be considered further when developing the operations plan for operating the disposal facility.

7.1.6 Typical Array Size

The moveable shielding wall set up between the crane and transporter operations and the placed package configuration will limit the proximity of package placement to between 15 meters (50 feet) and 7.5 meters (25 feet) of the crane. The 7.5 meters (25 feet) usable range of the crane reach, working over the shielding wall, and the ten or twelve maximum package width (because of dose rate limitation) determines the nominal array size that can be placed by the crane from a single set point. The 1.22 meters (4 feet) diameter ILAW packages will be staggered in the array to minimize the space between the packages. A column that is five packages deep can fit within the 7.5 meters (25 feet) available range of the crane reach while working over the shield wall. A width of ten packages is within the reach of the crane and is less than the allowable limits for the dose rate. Allowing for a 10 centimeters (4 inches) average tolerance in package placement, the five-row by ten-package-wide array is roughly 6 meters (20 feet) deep by 13.3 meters (44 feet) wide. A typical array is shown in Appendix D, Drawing D.1-1.

7.1.7 Cover Soil

Prior to the shield wall being relocated, the crane will place interstitial soil material between the packages, using a hopper. The filling operation is expected to take about one shift, according to the CDR, using up the balance of the two days needed to move the shield wall. To make up the time spent moving the shield wall and placing the interstitial fill soil, the average rate of package placement will have to be increased to seven packages per day for five days, according to the CDR.

While the shield wall is being relocated, a soil cover will be placed over the packages from on top of the lift of previously placed packages. Dump trucks will drive over the previously covered portion of the array and back up to near the edge of the packages that are still exposed and dump a load of fill soil for spreading by a bulldozer. The soil will be spread over the top of the top and exposed side of the array. The side slope from soil, cascading off the top, will be formed in no less than 1.5 H: 1V for reasons of safety, and will use approximately a 5-meter (16-foot) wide space between lines of arrays. Approximately 300 cubic meters (400 cubic yards) of soil will be required to cover the top and side of the five-row-deep by ten-package-wide array. The cover soil will be held back from the advancing end of the array so that the toe of the cover soil does not extend beyond the outer package in the array. This will allow the next array to be placed in close proximity to the previous array. After the bulldozer spreads the soil to a somewhat uniform 1-meter-plus thickness over the packages, a sheepsfoot-style compactor will make several passes to consolidate the fill soil. The cover soil effort will take approximately 12 hours or two shifts, as estimated in the CDR, and will take place at the same time that the portable shield wall is being relocated.

7.1.8 Failed Melter Disposal Area (Note: Disposal of failed melters is not permitted at this time by this permit.)

Failed melters can be disposed of as MLLW in Cell 1. A failed melter disposal area is provided on the bottom of Cell 1 at the southern toe of the waste lifts. Disposing of the failed melters in this area would eliminate placing them within the lifts along with the ILAW packages and other MLLW.

7.1.9 Access Ramps

Two 30-foot wide access ramps will be built into the south slope of the waste lifts to accommodate the movement of transport vehicles and equipment from one lift to the next. A third access ramp will be built through the north shine berm onto the top of the third lift to accommodate transport vehicles and equipment during the construction of Phase II, when the access ramp leading down the south excavation slope to the bottom of Phase I will be removed. The access ramp into Cell 1 and the access ramp from the north side would have a maximum slope of 5 percent to accommodate failed melter transporters, if it becomes necessary to dispose of the melters in the waste lifts rather than in the designated area at the bottom of Cell 1. The access ramp into Cell 2 would have a maximum slope of 8 percent that would accommodate the ILAW, DBVS containers, and LLW waste transporters. The access ramps at the bottom of Phase I would have minimum outside turning radii of 75 feet, to accommodate the failed melter transporters. The dimensions of the access ramps provide flexibility to accommodate the various waste haul vehicles that could use the ramps.

7.1.10 Filling Lift 1

Filling of remote handle ILAW and DBVS waste in Cell 1 will begin in the northwest corner and proceed to the southeast. Filling of remote handle LLW in Cell 2 will begin in the northeast corner and proceed to the southwest. Filling of contact handle LLW will begin in the northwest corner of cell 2 and proceed southeast (see Appendix D, Drawing D.1-2). This filling approach places the remote handle wastes farthest apart from each other, with contact handle wastes between them, and eliminates the need for additional shielding provisions that would be necessary if the two remote handles wastes were located adjacent to each other. This filling approach will be continued in the three subsequent lifts.

Nearly all of Lift 1 can be filled with the crane and transporters, operating from the top of the first operations layer. A 5-meter (17-foot) wide separation will be maintained between Cell 1 and Cell 2 to separate the ILAW and DBVS waste from the LLW. This separation area will be filled with soil. Using a low permeability soil in this area will maximize separation of leachate between the two cells. Two access lanes (ramps) will be maintained into the cells for transporter access. The transporters can turn around within the cells until the packages are within 7.5 meters (25 feet) of the area needed for the unloading operations.

Before the space for filling Lift 1 from the top of the first operations layer is consumed, the two access ramps will be extended with soil and contact handle waste to the top of Lift 1. The crane and transporters will go to the top of Lift 1 and will finish placing the remainder of the Lift 1 waste packages from the top (see Appendix D, Drawing D.1-3). At this point, it will also be possible to begin using the failed melter disposal area (also shown on Drawing D.1-3).

7.1.11 Filling Lift 2

Lift 2 will be filled similarly to Lift 1 (see Appendix D, Drawing D.1-4). This filling approach will continue the pattern that was established in Lift 1. Nearly the entire lift can be filled with the crane and transporters operating on the top of Lift 1. The 5-meter (17-foot) wide soil-filled separation will be maintained between Cell 1 and Cell 2 to separate the ILAW and DBVS waste from the LLW. The two access ramps will be maintained into both cells for transporter access. The transporters can turn around within the cells until the packages are within 7.5 meters (25 feet) of the area needed for the unloading operations. Before the space for filling Lift 2 from the top of Lift 1 is consumed, the two access ramps will be extended with soil and contact handle waste to the top of Lift 2. The crane and transporters will go to the top of Lift 2 and will finish placing the remainder of the Lift 2 waste packages from the top (see Appendix D, Drawing D.1-5).

7.1.12 Filling Lift 3

Lift 3 will be filled similarly to Lift 2 (see Appendix D, Drawing D.1-6). Nearly the entire lift can be filled with the crane and transporters operating on the top of Lift 2. The 5-meter (17-foot) wide soil-filled separation will be maintained between Cell 1 and Cell 2 to separate the ILAW and DBVS waste from the LLW. Two access ramps will be extended into the cells for transporter access. The transporters can turn around within the cells until the packages are within 7.5 meters (25 feet) of the area needed for the unloading operations. Before the space for filling Lift 3 from the top of Lift 2 is consumed, the two access ramps will be extended with soil and contact handle waste to the top of Lift 3. The crane and transporters will go to the top of Lift 3 and will finish placing the remainder of the Lift 3 waste packages from the top (see Appendix D, Drawing D.1-7).

7.1.13 Filling Lift 4

Lift 4 will be filled similarly to the previous three lifts, but with a few differences (see Appendix D, Drawing D.1-8). Most of the lift can be filled with the crane and transporters operating on the top of Lift 3, using the access ramps from the south. However, only the easterly access ramp from the south is planned to be extended to the top of Lift 4 for transporter access. The westerly access ramp from the south will not be extended because, as shown on Appendix D, Drawing D.1-9, it would reach the top of Lift 4 too close to the west side slope to accommodate an adequate turning radius for the transport vehicles. The access ramp will be blocked by waste placement in Cell 1. However, with some minor adjustment in its location and/or increase in its slope, it will be possible to extend the access ramp into Cell 1, if desired. Also, at some point during the filling Lift 4, construction for Phase II to the south will begin, and the access road from the south will be removed from service.

Prior to the westerly access ramp becoming blocked with waste and the access road from the south removed for construction of Phase II, a third access ramp will be constructed from the north down onto the top of Lift 3 to provide additional access. This access ramp will maintain separation between Cell 1 and Cell 2, to separate the ILAW and DBVS waste from the LLW. The transporters can turn around within the cells until the packages are within 7.5 meters (25 feet) of the area needed for the unloading operations.

Before the space for filling Lift 4 from the top of Lift 3 is consumed, the easterly access ramp will be extended with soil and contact handle waste to the top of Lift 4, and the access ramp from the north will be graded out onto the top of Lift 4. The crane and transporters will go to the top of Lift 4 and will finish placing the remainder of the Lift 4 waste packages from the top (see Appendix D, Drawing D.1-9). Completion of Lift 4 will end the filling operations in Phase I. The configuration at the end of Lift 4, prior to placement of the final cover system, is shown on Appendix D, Drawing D.1-10.

7.1.14 Transitioning between Lifts

As the available operating space in a lift gets smaller, operations efficiency will decrease to a point where it will become necessary to move part of the operations to the next lift before the active lift is completed. This will allow completion of each lift, using selected waste that will be easier to handle in the remaining space available on the lift. An example of this would be to use only contact handle waste to complete the filling of each lift while operating on the top of the lift that is being completed (see Appendix D, Drawings D.1-3, -5, -7, and -9) and sending all remote handle waste into the next lift.

7.1.15 Planning for Phase II and Operations During Phase II Construction

Phase II will need to be constructed and ready for operations sufficiently ahead of completion of filling operations in Lift 4 of Phase I to allow a smooth transition without operational constraints. Planning, design, and construction of Phase II may require several years. Phase II should be planned to be ready for operation at least six months, and preferably one year or more, before Lift 4 in Phase I is anticipated to be completed. This will provide a reasonable margin for changes in the incoming waste quantities and other variables while still having Phase II ready for operation, prior to reaching capacity in Phase I.

While Phase II is under construction, the access road on the west will be out of service for a period of time and the access ramp on the south into Phase I will be removed. During this time, it will be necessary for all waste transport vehicles to enter Phase I, using the access ramp on the north side. As currently designed, some access roads on the west and north sides of Phase I that normally would be used to reach the north access ramp might not accommodate all of the transport vehicles. In particular, the berm access road on the west side of Phase I and the access roads around the leachate storage tanks on the north do not have widths and turning radii as large as required by the waste transport vehicles. These roads would have to be widened and their turning radii increased to meet the requirements for transport vehicles, particularly the failed melter transporters.

7.2 OPERATIONAL INTERFACES

Operations and maintenance procedures will be prepared in the future as a separate project. These procedures will address operations, monitoring, and maintenance activities for the IDF.

This section of the Design Report presents important operational interfaces that have been identified by the design team. These interfaces should be considered during preparation of the operation and maintenance procedures. The interfaces are grouped by three categories–landfill excavation, liner system, and leachate handling system.

7.2.1 IDF Landfill Excavation and Related Subsystems

Operational interfaces for the landfill excavation and related subsystems include the following:

- Due to the containerized nature of the waste, the landfill is designed to be filled in a bottom-up fashion in four or more layers. The number of layers will depend on waste package size. Some waste packages may be larger in dimension than the ILAW packages. Operational procedures should be developed to accommodate various package sizes and their placement.

- Clean fill placement between waste packages must be done to minimize the potential for future consolidation and potential subsidence.

- Operations layer on side slopes of IDF will be monitored for material loss due to wind and water erosion. Lost material should be replaced. Annual application of spray-on type soil stabilization material to exposed areas of Phase I IDF should be considered.

- Shine berms should be monitored for erosion and height and should be repaired as necessary. Erosion control matting on the berm will be maintained and repaired or replaced if damage occurs.

- Stormwater control facilities should be maintained annually. Maintenance would include debris removal from the ditches and application of weed control. Periodically, if capacity of infiltration areas is diminished due to collection of fines, fines removal will be necessary. To maintain infiltration capacity, no other vehicle access should be allowed into these areas.

- Stormwater accumulation in the in-cell excavation infiltration area should be visually monitored. Pumping of the area may be necessary if accumulation becomes significant (near liner levels) in wet weather seasons. Periodically, if capacity of infiltration areas is diminished due to collection of fines, fines removal will be necessary. To maintain infiltration capacity, no other vehicle access should be allowed into these areas.

- Due to the heavy wheel loads on the access roads and ramps, gravel surfacing will be maintained with regular maintenance. Maintenance activities may include addition of more top course material, and grading and compaction of this material.

- Active faces of stockpiles will require periodic application of spray-on soil stabilization material.

7.2.2 IDF Liner System

Operational interfaces for the lining system include the following:

- Only equipment with ground pressures less than 4,400 lb/ft should be used for construction and maintenance on the side slopes, when operating directly on the operations layer. Bulldozers or other equipment may operate on the side slopes until a rain event in excess of 0.15 inches per hour occurs. In that event, equipment should be kept off of the side slope (directly on the operations layer) and should not be permitted to operate on slopes until two hours after the end of the rainfall event. The precipitation event applies to both the lined slopes and the unlined slopes at the southern end of the Phase I cell.

- For equipment on ramps, equipment should be kept a minimum of 2 feet away from the edge of ramps, to avoid localized sloughing of the ramp edges.

- When operating equipment or placing waste on the operations layer above the lining system, care should be taken to avoid damaging the liner. Special care will be necessary for equipment operation on the side slopes.

- Any loads placed on the surface of the first operations layer must be examined to verify that they do not create loads on the lining system in excess of the allowable GCL bearing capacity. As an example, different types of waste other than canisters should be examined as the waste plan is more fully developed. Care should also be taken to avoid impact loading, such as dropping a canister.

    - For static loading (such as for a barrier wall), refer to the discussion in Section 5.2 and Appendix C.2.

    - For operational/equipment loading, refer to the discussion in Section 5.5.5 and Appendix C.5.e to determine applicable load limits and crane dunnage requirements.

- The waste plan, as it is developed, should be followed for placement and density requirements. Any revisions to the proposed waste filling plan (discussed in Section 7.1) should be reviewed by the design engineer, to evaluate impacts on the waste/fill global stability analyses (Section 5.1.3 and Appendix C.1.c).

- As part of the waste/fill global stability analyses, the waste mass was considered internally stable for this design effort. Internal waste mass stability is a function of the waste filling approach. There are numerous options available to stabilize the waste through operational methodologies, such as providing a greater soil buttress on the open 3:1 south slope. During subsequent design phases, the internal stability of the waste should be evaluated in conjunction with the waste filling plan.

7.2.3 IDF Leachate Handling System

Operational interfaces for the leachate handling system include the following:

- Coordinate with Liquid Effluent Retention Facility (LERF) for leachate hauling and removal of leachate from tanks to satisfy the 90-day accumulation period (Treatment capacities at LERF and leachate flows for critical periods should also be coordinated. See Section 5.9.2.4 for additional leachate hauling constraints.)

- Use leak detection history for leachate storage tanks, during the operation of IDF, to manage and plan for replacement of tank liner system and temporary storage required during its replacement

- Periodic preventative inspection and maintenance for all rotating equipment should be scheduled.

- For leachate tanks floating covers, rain or snow will need to be pumped off with the manufacturer-included sump pump (mounted on side of tank). Water should not be allowed to accumulate except at the perimeter of the floating cover. Excessive water may prevent vent operation and cause mixing between precipitation water and leachate on top of the cover.

- An adequate store of critical spare electrical and mechanical parts should be maintained.

- All valves should be exercised at least annually.

- A small "contractor-type" trash pump with hose should be kept on hand that can be used to pump from the leak detection chamber within the combined sump to its inner sump.

- Periodically, test operation of the combined sump pump should be done.

- Annual testing of all leachate pumps for proper operation should be scheduled.

- Regular verification of level transducer calibration in cells should be done.

- Prior to winter months, proper operation of all heat tracing system should be checked.

- Periodic testing of all control relays, switches and contacts should be scheduled.

- Additional operational interface items will be developed, based on completion of design of the control system for the leachate handling system. This will be part of the IDF administration building design.

- Maintenance should be provided in accordance with manufacturer's recommendations.

7.3 LEAKAGE RESPONSE ACTION PLAN

WAC 173-303-665(9) regulations require the owner of the operator of a landfill unit to have an approved Response Action Plan (RAP) before receipt of waste. The RAP is a site-specific plan that establishes actions to be taken if leakage through the upper (primary) lining system of a landfill exceeds a certain rate. The intent of the RAP is to assure that any leachate that leaks through the primary lining system will not migrate out of the landfill into the environment.

A key element of the RAP is the ALR, a threshold value which triggers the responses described in the RAP, but below which no special actions are required. Because landfill liner systems have not yet been perfected, a small amount of leakage through the primary liner generally occurs, despite the use of best available materials, construction techniques, and QA procedures. (This leakage is collected by the LDS system and removed from the landfill.) Hence, the ALR is set at some level higher than normally expected leakage rates to serve as an indicator that the primary lining system is not functioning as expected. Exceeding the ALR may reflect serious failure of the primary lining system and indicates the need for investigation and possibly corrective action while the problem is still manageable.

This RAP has been prepared in accordance with requirements of WAC 173-303-665(9). The requirements for determining the ALR are contained in WAC 173-303-665(8) and EPA guidance document, *Action Leakage Rates for Leak Detection Systems* (EPA 1992a).

The following sections establish the ALR and discuss response actions to be taken if the ALR is exceeded.

7.3.1 Action Leakage Rate

Section 5.11 provides a detailed discussion of the analysis to determine the ALR into the LDS for the IDF. Based on this analyses, the ALR for each IDF cell is 206 gallons per acre per day, or approximately 1,800 gallons per day per cell (each cell area is approximately 8.5 acres). This value includes a factor of safety of 2 in accordance with EPA guidelines (EPA 1992b). It is also much lower than the LDS pump capacity. Details of the calculation are presented in Appendix C.10.

In accordance with WAC 173-303-665(8)(b), the flow rate used to determine if the ALR has been exceeded will be calculated as the average daily flow rate into the sump, expressed as gallons per acre per day (unless Ecology approves a different calculation). This calculation will be performed on a weekly basis during the active (operational) life of the landfill, and monthly after the landfill has been closed. Post-closure frequency may be reduced if only minimal amounts of leachate accumulate in the LDS sump. As outlined in WAC 173-303-665(4)(c)(ii), during post-closure monitoring, if the liquid level in the LDS sump stays below the pump operating level for two consecutive months, monitoring of the amount of liquid in the LDS sumps can be reduced to at least quarterly. If the liquid level in the LDS sump stays below the pump operating level for two consecutive quarters, monitoring of the amount of liquid in the LDS sumps can be reduced to at least semiannually. Pump operating level is defined as a liquid level approved by Ecology, based on pump activation level, sump dimensions, and level that minimizes head in the sump.

7.3.2 Response Actions

WAC 173-303-665(9) lists several required actions if the ALR is exceeded. In the event that the ALR is exceeded, DOE will:

1. Notify Ecology in writing of the exceedance within 7 days of the determination

2. Submit a preliminary written assessment to Ecology within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, cause of any leaks, and short-term actions taken and planned

3. Determine, to the extent practicable, the location, size , and cause of any leak

4. Determine whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed

5. Determine any other short-term and longer-term actions to be taken to mitigate or stop any leaks

6. Within 30 days after the notification that the ALR has been exceeded, submit to Ecology the results of the analyses specified in bullets 3, 4, and 5 of this section, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the LDS exceeds the ALR,

the owner or operator must submit to the regional administrator a report summarizing the results of any remedial actions taken and actions planned.

If the ALR is exceeded, the DOE will submit the required notifications to Ecology, as stated above. The EPA will also receive copies of this confirmation.

The leachate will be analyzed for chemical compounds and radionuclides. If the analytical results indicate that these constituents are present, and if the constituents can be traced to a particular type of waste stored in a known area of the landfill, then it may be possible to estimate the location of the leak. However, because the waste will meet land disposal restrictions, it will contain no free liquids and will be stabilized or solidified. In addition, the canister(s) or other type of waste package(s) may not undergo enough deterioration during the active life of the landfill to permit escape of its contents. For these reasons, it is possible that the leachate may be clean or the composition too general to indicate a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the landfill. Backfill would need to be removed from around the waste packages to accomplish this. If the waste packages are damaged during this process, the risk of accidental release may be high. For these reasons, large scale removal of waste and liner system materials is not considered a desirable option and will not be implemented except as a last resort.

The preferred options for remediation include covers and changes in landfill operating procedures. The preferred alternative will depend on factors such as the amount of waste already in the landfill, the rate of waste receipt, the chemistry of the leachate, the availability of other RCRA-compliant disposal facilities, and similar considerations. Hence, at this time no single approach can be selected. If the ALR is exceeded, potential options will be evaluated prior to selecting a remediation process. If necessary, an interim solution will be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following:

- The surface of the intermediate soil cover over the waste could be graded to direct runoff into a shallow pond. The surface would then be covered with a discardable, temporary geomembrane (e.g., 30-mil PVC or reinforced polypropylene). Precipitation water would be pumped or evaporated from the pond and would not infiltrate the waste already in the landfill. Waste packages would be placed only during periods of dry weather and stored temporarily at other times. This type of approach would also be used, if necessary, to reduce leakage during the time immediately after the ALR was exceeded, while other remediation options were being evaluated.

- If the landfill was nearly full, partial construction of the final closure cover might be an option. This would reduce infiltration into the landfill and possibly the leakage rate, if the cover was constructed over the failed area.

- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second "primary" liner higher in the landfill. This new liner would intercept precipitation and allow its removal.

- A rigid-frame or air-supported structure could be constructed over the landfill to ensure that no infiltration occurred. Although costly, this approach might be less expensive than constructing a new landfill.

In general, the selected remediation efforts would be those that are easiest to implement, with more difficult or expensive options to be applied only if earlier approaches were not satisfactory.

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