

HWMA/RCRA PARTIAL PERMIT

FOR STORAGE AT THE

CALCINED SOLIDS STORAGE FACILITY

AT THE

IDAHO NUCLEAR TECHNOLOGY

& ENGINEERING CENTER

ON THE

IDAHO NATIONAL LABORATORY

EPA ID NO. ID4890008952

Revision Date: December 17, 2025

Book 1 of 1

PERMIT

PERMIT -
INTRODUCTION
through ACRONYMS

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

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C. L. "Butch" Otter, Governor
John H. Tippets, Director

Permittee: **Department of Energy (DOE) and DOE-Designated Contractors, Idaho National Laboratory (INL) Partial Permit Number: EPA ID# ID4890008952**

INTRODUCTION AND SIGNATURE PAGE

Pursuant to the Idaho Hazardous Waste Management Act of 1983 (HWMA), Idaho Code § 39-4401 *et seq.*, and the "*Rules, and Standards For Hazardous Waste*," as amended, IDAPA 58.01.05.000 *et seq.*, specifically IDAPA 58.01.05.012 [40 Code of Federal Regulations (CFR) § 270.1(c)(4)], a Partial Permit (for less than the entire facility) is hereby issued to the United States Department of Energy (DOE) and DOE-designated contractor (see Permit Definitions), hereinafter called the Permittee, to operate a hazardous waste storage facility at the Idaho Nuclear Technology and Engineering Center (INTEC), located on the Idaho National Laboratory (INL), located in Butte County, Idaho.

The Permittee shall comply with all of the terms and conditions of this Partial Permit (Permit), and Attachments 1 through 9 of this Permit. The Permittee shall comply with all applicable state regulations, including IDAPA 58.01.05.004 through 58.01.05.013 [40 CFR, Parts 124, 260 through 266, 268, and 270], and as specified in this Permit.

Applicable state regulations are those which are in effect on the date of final administrative disposition of this Permit and any self-implementing statutory provisions and related regulations which, according to the requirements of the Hazardous and Solid Waste Amendments (HSWA), are automatically applicable to the Permittee's hazardous waste management activities, notwithstanding the conditions of this Permit.

This Permit is based upon the administrative record, as required by IDAPA 58.01.05.013 [40 CFR § 124.9]. The Permittee's failure, in the application or during the permit issuance process, to fully disclose all relevant facts, or the Permittee's misrepresentation of any relevant facts, at anytime, shall be grounds for the termination or modification of this Permit and/or initiation of an enforcement action, including criminal proceedings. To the extent there are inconsistencies between the Permit and the attachments, the language of the permit shall prevail. The Permittee must inform the Director of the Idaho Department of Environmental Quality (hereinafter referred to as "Director") of any deviation from the permit conditions or changes in the information on which the application is based, which would affect the Permittee's ability to comply or actual compliance with the applicable regulations or permit conditions, or which alters any permit condition in any way. The Director shall enforce all conditions of this Permit, which are designated in this Permit as state requirements. Any challenges of any permit condition that concern requirements shall be appealed to the Director, in accordance with IDAPA 58.01.05.996 and the Idaho Department of Environmental Quality Rules and Regulations 58.01.23, *"Rules of Administrative Procedure Before the Board of Environmental Quality."*

This Permit is effective as of **June 26, 2017** and shall remain in effect until **June 26, 2027**, unless, in accordance with IDAPA 58.01.05.012, the Permit is revoked and reissued [40 CFR § 270.41], modified [40 CFR § 270.42, Appendix I.A.6], terminated [40 CFR § 270.43], or continued [40 CFR § 270.51].

May 22, 2017
Date

John H. Tippets, Director
Idaho Department of Environmental Quality

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LIST OF ATTACHMENTS

The following documents are excerpts from the Permittee's Administrative Record, i.e., HWMA/RCRA Permit Reapplication for the INTEC Calcined Solids Storage Facility (CSSF) dated May 2016; Book 1 supplemental reports, and other documents contained in the Department's supporting file for the draft Permit. The Director, as deemed necessary, modified specific language in the Attachments. These modifications are described in the permit conditions (Modules I through IV) and, thereby, supersede the language of the original attachment. If the language of the Permit conflicts with either the attachments or the original reapplication, the language in the Permit shall prevail. These incorporated attachments are enforceable conditions of this Permit, as modified by the specific permit condition(s).

ATTACHMENT 1 INL FACILITY DESCRIPTION, consisting of:

Volume 22: CSSF Part B Permit; Pages as identified below;

1 Part A [December 2025]
2 Section B: Facility Description (pages i-6) [May 2016]
3 Section D: Process Information (pages i-14) [May 2016]

ATTACHMENT 2 WASTE ANALYSIS PLAN

Volume 22: CSSF Part B Permit; Section C: Waste Characteristics (pages i-21) [December 2025]

ATTACHMENT 3 SECURITY

Volume 22: CSSF Part B Permit; Section F-1: Security (pages i-2) [May 2016]

ATTACHMENT 4 INSPECTIONS

Volume 22: CSSF Part B Permit; Section F-2: Inspection Schedule (pages i-3), Appendix F-1 (schedule) and Appendix F-2 (inspection forms) [December 2025]

ATTACHMENT 5 PERSONNEL TRAINING at the INTEC consists of:

Volume 22: CSSF Part B Permit; Section H: Personnel Training (pages i-9)

ATTACHMENT 6 PROCEDURES TO PREVENT HAZARDS

Volume 22: CSSF Part B Permit; Sections F-3, F-4, F-5: Procedures to Prevent Hazards (pages i-3) [May 2016]

ATTACHMENT 7 CONTINGENCY PLAN

Volume 22: CSSF Part B Permit; Section G: Contingency Plan (pages i-26) [December 2025]

ATTACHMENT 8 CLOSURE PLAN

Volume 22: CSSF Part B Permit; Section I: Closure and Post Closure Requirements (pages i-11) [December 2025]

ATTACHMENT 9 PERMIT REVISION LOG

Volume 22: CSSF Part B Permit; Revision Log (pages i-1) [December 2025]

LIST OF APPENDICES

APPENDIX 1	CSSF Facility Drawing List and Drawings [May 2016]
APPENDIX 2	Tank System Integrity Assessment [May 2016]
APPENDIX 3	Representative Calcine Sample Analytical Data [May 2016]
APPENDIX 4	CSSF Engineering Design File [May 2016]
APPENDIX 5	Section E: Groundwater Monitoring [May 2016]
APPENDIX 6	Section J: Corrective Action for Solid Waste Management Units [December 2025]
APPENDIX 7	Section K: Other Federal Laws [May 2016]
APPENDIX 8	Section L: Certification Statements [May 2016]

DEFINITIONS

For purposes of this Permit, the following definitions shall apply:

a. "Application" shall mean the following: The HWMA/RCRA Part B Permit Application for the Idaho National Laboratory, Volume 22, Calcined Solids Storage Facility, Book 1 Revision 0, May 2016, and all DEQ approved Permit Modifications as detailed in Attachment 9, Permit Revision Log.

b. "Calcine" shall mean the granular solid mixed waste, without free liquids, derived from either the Waste Calcining Facility or the New Waste Calcining Facility, regulated as hazardous under IDAPA 58.01.05.005 [40 CFR 261, Subparts C and D] and radioactive under the Atomic Energy Act.

c. "Days" shall mean calendar day(s) unless otherwise specified. Any requirement of submittal under the terms of this Permit that would be due on a Saturday, Sunday, or a state or federal holiday shall be due on the following business day."

d. "Department" shall mean the Idaho Department of Environmental Quality.

e. "Director" shall mean the Director of the Department of Environmental Quality, or his designee, or authorized representative.

f. "Discovery (discovered)" shall mean the initial identification of a SWMU or other Area of Concern, which has the potential to release hazardous waste or hazardous waste constituents to the environment.

g. "DOE" shall mean the United States Department of Energy.

h. "Facility" shall mean all contiguous land, structures, other appurtenances, and improvements under the control of the Department of Energy at the Idaho National Laboratory (INL) for total of approximately 890 square miles or 601,260 acres

i. "HSWA" shall mean the Hazardous and Solid Waste Amendment of 1984.

j. "HWMA" shall mean the State of Idaho, Hazardous Waste Management Act of 1983, as amended, Idaho Code § 39-4401 et seq.

k. "Hazardous Waste" shall mean a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, or chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed [See 42 USC § 6903(5)].

l. “Hazardous Waste Constituent” shall mean any constituent identified in Appendix VIII of IDAPA 58.01.05.005 [40 CFR Part 261], or any constituent identified in Appendix IX of IDAPA 58.01.05.008 [40 CFR Part 264].

m. “Hazardous Waste Management Unit (HWMU)” shall mean those operable units subject to the requirements of IDAPA 58.01.05.012 [40 CFR §§ 270.14 through 270.25].

n. “Mixed waste” shall mean waste that is both hazardous and radioactive.

o. "Operator" shall mean Idaho Environmental Coalition, LLC (IEC), the DOE-designated contractor that has responsibilities and control of the HWMU.

p. “Owner” shall mean the United States Department of Energy (DOE).

q. “Permittee” shall mean both DOE, as owner, and the DOE Contractor as operator.

r. “RCRA” shall mean the Resource Conservation and Recovery Act of 1976, as amended by HSWA in 1984.

s. “Release” shall mean any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of hazardous wastes (including hazardous waste constituents) into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing hazardous wastes or hazardous waste constituents).

t. “Solid Waste Management Unit” (SWMU) shall mean any discernable unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous wastes. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

All definitions contained in IDAPA 58.01.05.004, .005, .008, and .010 through .013 [40 CFR Parts 260, 261, 264, 266, 268, 270, and 124] are hereby incorporated, in their entirety, by reference into this Permit, except that any of the definitions used above shall supersede any definition of the same term given in IDAPA 58.01.05.000 et seq. Where terms are not defined in the regulations or the Permit, the meaning associated with such terms shall be defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

LIST OF TABLES

TABLE 1 REQUIRED SUBMITTALS and DATES

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ACRONYMS AND ABBREVIATIONS

ALARA	As low as reasonably achievable
ASTM	American Society for Testing and Materials
CAMs	Continuous air monitors
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CSM	Critical Systems Maintenance
CSSF	Calcined Solids Storage Facility
DCS	Distributed Control System
DEQ	Department of Environmental Quality
DOE	Department of Energy
DOE-ID	Department of Energy, Idaho Operations Office
DOT	Department of Transportation
DQO	Data Quality Objectives
EAL	Emergency Action Level
EAM	Emergency Action Manager
EC	Emergency Coordinator
ED	Emergency Director
EDF	Engineering Design File
EMCAP	Environmental Management Consolidated Audit Program
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EP/RCRA CP	Emergency Plan/Resource Conservation and Recovery Act Contingency Plan
ERO	Emergency Response Organization
FAC	Fire Alarm Center
FFA/CO	Federal Facility Agreement/Consent Order
GERT	General Employee Radiation Training
HEPA	High-Efficiency Particulate Air
HSWA	Hazardous and Solid Waste Amendments of 1984
HWMA	Hazardous Waste Management Act of 1983, as amended
HWMU	Hazardous Waste Management Unit
HWNs	Hazardous Waste Numbers
IBC	International Building Code
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LDR	Land Disposal Restrictions
M&O	Management and Operations
MOU	Memoranda of Understanding
MSDS	Material Safety Data Sheet
NRC	Nuclear Regulatory Commission
NWCF	New Waste Calcining Facility
OJT	On-the-Job Training

OSC	On-Scene Commander
OSHA	Occupational Safety and Health Administration
P&ID	Piping and Instrumentation Diagram
PE	Professional Engineer
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
RA	Radiological Assay
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SAT	Systematic Approach to Training
SBW	Sodium-Bearing Waste
SPOs	Security Police Officers
SRPA	Snake River Plain Aquifer
STP	INL Site Treatment Plan
SW-846	Test Methods for Evaluating Solid Waste: Physical/Chemical Methods
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TSDF	Treatment, Storage, and Disposal Facility
UBC	Uniform Building Code
UHC	Underlying Hazardous Constituent
USGS	United States Geological Survey
WAC	Waste Acceptance Criteria
WAP	Waste Analysis Plan
WCC	Warning Communications Center
WCF	Waste Calcining Facility
WDDF	Waste Determination and Disposition Form
WGS	Waste Generator Services

PERMIT - MODULE I
STANDARD PERMIT
CONDITIONS

MODULE I - STANDARD PERMIT CONDITIONS

I.A. EFFECT OF PERMIT

The Permittee is allowed to store mixed waste in the Idaho Nuclear Technology and Engineering Center (INTEC), Calcined Solids Storage Facility (CSSF) in accordance with the conditions of this Partial Permit. Any storage of mixed waste in the Hazardous Waste Management Units (HWMU), described herein, not authorized in this Permit, is prohibited.

Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.4], compliance with this Permit generally constitutes compliance (for purposes of enforcement) with the Idaho Hazardous Waste Management Act (HWMA), as amended, except for those requirements not included in this Permit, which become effective by statute or future regulatory changes to include those requirements promulgated under IDAPA 58.01.05.011 [40 CFR Part 268] restricting the placement of hazardous waste in or on the land. Issuance of this Permit does not convey any property rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local laws or regulations.

I.A.1. The Department of Energy (DOE) is the owner and is responsible for activities which include, but are not limited to, policy, programmatic funding, and scheduling decisions, as well as the overall management and operation of the facility.

I.A.2. The DOE-designated contractor, as operator, is responsible for the day-to-day operations of the assigned permitted units and for all permitted activities related to the assigned units, for which the DOE-designated contractor, its agents, employees, or subcontractors have operational responsibilities and control, including waste characterization and handling, monitoring, record keeping, reporting, and contingency planning.

I.B. ENFORCEABILITY

The terms and conditions of this Permit are enforceable pursuant to the HWMA or any other applicable federal, state, or local law. Violations of this Permit may result in civil penalties, in accordance with the HWMA [Idaho Code § 39-4414] and the HWMA Civil Penalty Policy.

I.B.1. Any person who knowingly makes any false statement or representation in any application, label, manifest, record, report, permit, or other document filed, maintained or used, for the purposes of complying with the provisions of Idaho Code § 39-4415, shall be guilty of a misdemeanor and subject to the maximum daily fine allowed by law or to imprisonment not to exceed one (1) year, or to both, for each separate violation or for each day of a continuing violation.

I.C. OTHER AUTHORITY

The Department expressly reserves any right of entry provided by law, and any authority to order or perform emergency or other response activities as authorized by law.

I.D. PERMIT ACTIONS

I.D.1. This Permit may be modified, revoked and reissued, or terminated for cause, as specified in IDAPA 58.01.05.012 [40 CFR §§ 270.41, 270.42, or 270.43].

I.D.2. The filing of a request for a permit modification, revocation and reissuance, or termination, or the notification of planned changes or anticipated noncompliance on the part of the Permittee, does not stay the applicability or enforceability of any permit condition in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(f)].

I.D.3. The Director may modify this Permit when the standards or regulations on which the Permit was based have been changed by statute, amended standards or regulations, or by judicial decision after the effective date of this Permit.

I.D.4. Except as provided by specific language in this Permit or except for the Director's approval of a Class 1 or 2 Permit Modification, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42(a) and (b)], any modifications which substantially alter the facility or its operation (as covered by this Permit) shall be administered as a Class 3 Permit Modification prior to such change taking place, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.42(c)].

I.D.5. Within forty-five (45) days of a permit modification being put into effect or approved, the Permittee shall provide clean copies of the relevant portions of the Permit and Attachments to incorporate the change (if not already reflected/provided in the change pages submitted with the Permit Modification Request), reprint the documents (as necessary), and submit them to the Director in accordance with Permit Condition I.Y.

I.D.6 The Permittee shall ensure Attachment 9, "Modification Tracking Log" is current, consistent with Permit Condition I.D.5.

I.E. SEVERABILITY

I.E.1 The provisions of this Permit are severable, and if any provision of this Permit or the application of any provision of this Permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this Permit shall not be affected thereby. Invalidation of any state or federal statutory or regulatory provision, which forms the basis for any condition of this Permit, does not affect the validity of any other state or federal statutory or regulatory basis for said provision.

I.E.2 In the event that a condition of this Permit is stayed for any reason, the Permittee shall continue to comply with the related applicable and relevant permitted standards in IDAPA 58.01.05.008 [40 CFR Part 264] until final resolution of the stayed condition, unless compliance with the related applicable and relevant interim status standards would be technologically incompatible with compliance with other conditions of this Permit that have not been stayed.

I.F. DUTY TO COMPLY

I.F.1 The Permittee shall comply with all conditions of this Permit, except to the extent and for the duration such noncompliance is authorized by an emergency permit issued in accordance with IDAPA 58.01.05.012 [40 CFR § 270.61]. Any permit noncompliance (other than noncompliance authorized by an emergency permit) constitutes a violation of HWMA, and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification of the Permit, or denial of a permit renewal application as specified in IDAPA 58.01.05.012 [40 CFR § 270.30(a)]

I.F.2. Compliance with the terms of this Permit does not constitute a defense to any order issued or any action brought under §§ 3007, 3008, 3013, or 7003 of RCRA [42 U.S.C. §§ 6927, 6928, 6934, and 6973], §§ 104, 106(a), or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. §§ 9604, 9606(a), or 9607, commonly known as CERCLA], as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), or any other state or federal law providing for protection of public health or the environment from any imminent and substantial endangerment to human health or the environment.

I.G. 5-YEAR REOPENER and DUTY TO REAPPLY

I.G.1. This Permit shall be reviewed five (5) years after the effective date of this permit and modified as necessary to adjust for new technology concerning storage, inspection, removal and/or final disposition of the calcine.

I.G.2. If the Permittee wishes to continue an activity allowed by this Permit after the expiration date of this Permit, the Permittee must submit a new application a minimum of 180 calendar days prior to the expiration of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR §§ 270.10(h) and 270.30(b)]. Failure to submit a timely permit application, prior to completion of closure, will result in enforcement action in accordance with IDAPA 58.01.05.012 [40 CFR § 270.51(c)].

I.H. PARTIAL PERMIT EXPIRATION

Except as renewed, modified, revoked, reissued, or terminated by the Department, this Permit shall automatically expire ten (10) years from the effective date of this Permit.

I.I. CONTINUATION OF EXPIRING PERMIT

I.I.1. This Permit and all conditions herein shall continue in force until the effective date of a new permit, if the Permittee has submitted a timely and complete application in accordance with IDAPA 58.01.05.012 [40 CFR §§ 270.10, 270.13 through 270.29], and

through no fault of the Permittee, the Director has neither issued or denied a new permit under IDAPA 58.01.05.013 [40 CFR § 124.5] on or before the expiration date of this Permit.

I.I.2. If the Permittee fails to submit a timely and complete application (in accordance with IDAPA 58.01.05.012 [40 CFR §§ 270.10, 270.13 through 270.29]); the Permittee may be subject to the maximum daily fine allowed by law for each day of non-compliance. All Permit conditions herein shall continue in force through the period of non compliance (until the effective date of a new permit, or until the wastes have been removed and units have been clean closed in accordance with this permit).

I.J. NEED TO HALT OR REDUCE ACTIVITY NOT A DEFENSE

It shall not be a defense for the Permittee, in an enforcement action, that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit, as specified in IDAPA 58.01.05.012 [40 CFR § 270.30(c)].

I.K. DUTY TO MITIGATE

In the event of noncompliance with this Permit, the Permittee shall take all reasonable steps to minimize releases to the environment resulting from the noncompliance, and shall carry out such measures as are reasonable, to prevent significant adverse impacts on human health or the environment, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(d)].

I.L. PROPER OPERATION AND MAINTENANCE

The Permittee shall, at all times, properly operate and maintain all facilities and controls (and related appurtenances), which are installed or used by the Permittee, to achieve compliance with the conditions of this Permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary equipment or similar systems, only when necessary, to achieve compliance with the conditions of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(e)].

I.M. DUTY TO PROVIDE INFORMATION

The Permittee shall furnish to the Department and/or the Director, within a reasonable time, any relevant information which the Department and/or the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Permit, or to determine compliance with this Permit. The Permittee shall also furnish to the Department and/or the Director, upon request, copies of records required to be kept by this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(h)].

I.N. INSPECTION AND ENTRY

Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.30(i)], the Permittee shall allow the Department, the Director, and/or their authorized officers, employees or representatives (upon the presentation of credentials and other documents), as may be required by law, to:

I.N.1. Enter, at reasonable times, the Permittee's premises where a regulated facility or activity is located or conducted, or where records are kept as required by the conditions of this Permit;

I.N.2. Have access to, and copy, at reasonable times, any records that are kept as required by the conditions of this Permit;

I.N.3. Inspect at reasonable times any portion of the facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Permit; and

I.N.4. Sample or monitor, for the purposes of assuring permit compliance or as otherwise authorized by the HWMA or RCRA, any substances or parameters at any location.

I.O. MONITORING AND RECORDS

I.O.1 The Permittee shall retain copies of all reports required by this Permit, the certification required by IDAPA 58.01.05.008 and IDAPA 58.01.05.012 [40 CFR §§ 264.73(b)(9) and 270.30(j)(2)], and records of all data used to complete the application for this Permit for a period of at least three (3) years from the date of the report, record, or certification unless a longer retention period for certain information is required by other conditions of this Permit. This period may be extended by request of the Director at any time.

I.O.2. Pursuant to IDAPA 58.01.05.012 [40 CFR § 270.30(j)(3)], records of monitoring information shall specify the following:

I.O.2.a. The date(s), exact place, and times of sampling or measurements;

I.O.2.b. The name(s), of individuals who performed the sampling or measurements;

I.O.2.c. The date(s) analyses were performed;

I.O.2.d. The name(s), of individuals who performed the analyses;

I.O.2e. The analytical techniques or methods used; and

I.O.2.f. The results of such analyses, including the Quality Control/Quality Assurance summary.

I.O.3. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(j)(1)]. The method used to obtain a representative sample of the waste to be analyzed shall be the appropriate method from IDAPA 58.01.05.005 [40 CFR Part 261, Appendix I], or an equivalent method approved by the Director. Laboratory methods shall be Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846 (prevailing edition), Standard Methods of Wastewater Analysis (prevailing edition), or other director approved methods capable of measuring the defined parameter alternate methods approved in this Permit, or an equivalent method in accordance with Permit Condition I.O.4. of this Permit.

I.O.4 The Permittee must submit to the Director for approval, a request to deviate from approved or other recognized sampling methods in accordance with the following:

I.O.4.a. The request shall provide information demonstrating that the proposed method(s) requested to be substituted, are equivalent or superior in terms of sensitivity, accuracy, and precision (i.e., reproducibility); and

I.O.4.b. The Permittee receives a written approval from the Director for the substitution of analytical method(s). Such approval shall not require a permit modification under IDAPA 58.01.05.012 [40 CFR § 270.42].

I.P. REPORTING PLANNED CHANGES

The Permittee shall give notice to the Director as soon as possible prior to any planned physical alteration or additions to the permitted facility, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(1)].

I.Q. REPORTING ANTICIPATED NONCOMPLIANCE

The Permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity, which may result in noncompliance with requirements of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(2)]. Advance notice shall not constitute a defense for any noncompliance.

I.R. CERTIFICATION OF CONSTRUCTION OR MODIFICATION

I.R.1 The Permittee may not commence storage of mixed waste in a new permitted Hazardous Waste Management Unit or in a modified portion of an existing permitted Hazardous Waste Management Unit, except as provided in IDAPA 58.01.05.012 [40 CFR § 270.42], until the Permittee has submitted to the Director (by certified mail, express mail, or hand delivery) a letter, along with the attachments required under Permit Condition II.A.2., signed by the Permittee and a registered professional engineer certifying that the permitted unit(s) at the facility have been constructed or modified in accordance with the approved plans and specifications in compliance with this Permit, IDAPA 58.01.05.012 [40 CFR § 270.30(l)]; and

I.R.2. The Director has reviewed and inspected (if deemed appropriate) the modified or newly constructed unit(s), and has notified the Permittee in writing that the unit(s) were found in compliance with the conditions of this Permit; or

I.R.3. If within fifteen (15) calendar days after the date of submission of the letter in Permit Condition I.R.1. of this Permit, the Permittee has not received notice from the Director of the intent to inspect, prior inspection is waived and the Permittee may commence storage of hazardous waste in the permitted unit(s) certified, in accordance with Permit Condition I.R.1. of this Permit.

I.S. TRANSFER OF PERMIT

This Permit shall be transferred to a new owner or operator only if it is modified or revoked and reissued, pursuant to IDAPA 58.01.05.012 [40 CFR § 270.40]. Prior to transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator, in writing, of the requirements of IDAPA 58.01.05.008 and 58.01.05.012 [40 CFR Parts 264 and 270] and this Permit.

I.T. TWENTY-FOUR-HOUR REPORTING

I.T.1. In accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(6)], the Permittee shall verbally report to the Director and Idaho State Communications Center, any noncompliance with this Permit that may endanger human health or the environment within twenty-four (24) hours from the time the Permittee becomes aware of such noncompliance, including:

I.T.1.a. Noncompliance with Permit Condition II.A.1. of this Permit; or

I.T.1.b. Information concerning a release of any hazardous waste that may endanger public drinking water supplies; or

I.T.1.c. Any information of a release or discharge of mixed waste, or of a fire or explosion at the facility that could threaten human health or the environment outside the facility.

I.T.2. The description of the occurrence and its cause shall, at a minimum, include:

- Name, title, and telephone number of individual reporting;
- Name, address, and telephone number of the owner or operator;
- Name, address, and telephone number of the facility;
- Date, time, and type of incident;
- Location and cause of the accident;
- Name and quantity of materials involved;
- The extent of injuries, if any;
- An assessment of actual or potential hazards to the environment and human health, where this is applicable;
- Description of any emergency action taken to minimize possible threat(s) to human health and the environment;

- Estimated quantity and disposition of recovered material that resulted from the incident; and
- Any other information necessary to evaluate the situation and to develop an appropriate course of action.

I.T.3. Within five (5) calendar days after the Permittee is required to provide verbal notification, as specified in Permit Condition I.T.1. of this Permit, the Permittee shall provide to the Director a written submission. The written submission shall include, but not be limited to, the following:

- Name, address, and telephone number of individual reporting;
- A description (include cause, location, extent of injuries (if any), and an assessment of actual or potential hazard(s) to the environment and human health outside the facility (where this is applicable) of the incident (noncompliance and/or release);
- The period(s) in which the incident (noncompliance and/or release) occurred (including exact dates and times);
- Whether the results of the incident remain a threat to human health and the environment (whether the noncompliance has been corrected and/or the release has been adequately remediated); and
- If not, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance, and/or the steps taken or planned to adequately remediate the release.

I.T.4. The Permittee need not comply with the five (5) calendar-day, written notice requirement if the Director waives the requirement, and the Permittee submits a written report within fifteen (15) calendar days from the time the Permittee is required to provide verbal notification, as specified in Permit Condition I.T.1. of this Permit.

I.U. OTHER NONCOMPLIANCE

The Permittee shall report, on a semi-annual basis, all other instances of noncompliance, not otherwise required to be reported in accordance with Permit Condition I.T. of this Permit, in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(10)]. Reports shall be due on February 1 and August 1 of each year. The reports shall contain the information listed in Permit Condition I.T of this Permit. Reporting shall not constitute a defense for any noncompliance.

I.V. OTHER INFORMATION

Whenever the Permittee becomes aware that any relevant information was omitted in the permit application or incorrectly submitted in the permit application or in any report to the Director, the Permittee shall promptly submit such facts or information to the Director, in accordance with Permit Condition I.Y. of this Permit in accordance with IDAPA 58.01.05.012 [40 CFR § 270.30(l)(11)].

I.W. SIGNATORY REQUIREMENT

All applications, reports, or information requested by or submitted to the Director shall be signed and certified in accordance with IDAPA 58.01.05.012 [40 CFR §§ 270.11 and 270.30(k)].

I.X. CONFIDENTIAL INFORMATION

Pursuant to Title 9, Chapter 3, of the Idaho Code; IDAPA 58.01.05.012 [40 CFR § 270.12]; or any other applicable federal, state, or local law; the Permittee may assert a claim of confidentiality regarding any information required to be submitted pursuant to this Permit. The Department shall determine whether said information is exempt from disclosure, pursuant to applicable law.

I.Y. REPORTS, NOTIFICATIONS, AND SUBMISSIONS

All reports, notifications, or other submissions, which are required by this Permit and IDAPA 58.01.05.012 [40 CFR § 270.5], shall be sent or given to the Director in duplicate by certified mail, express mail, electronically, or hand delivered at:

Director c/o Hazardous Waste Program Manager
Idaho Department of Environmental Quality
1410 North Hilton
Boise, Idaho 83706-1255
Telephone No. (208) 373-0502

Twenty-four- (24) hour telephone number 1-800-632-8000

The address and telephone numbers listed above are current as of the effective date of this Permit and may be subject to change.

I.Z. DOCUMENTS TO BE MAINTAINED BY THE PERMITTEE(S)

I.Z.1. The Permittee shall maintain until closure is completed and certified by a registered, professional engineer (unless otherwise stated), the following documents as well as any/all amendments, revisions and/or modifications to these documents as follows:

I.Z.1.a. A complete copy of this Permit including attachments, tables and modifications.

I.Z.1.b. Waste Analysis Plan(s), for each HWMU of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264.13] and this Permit;

I.Z.1.c. Operating Record, as required by IDAPA 58.01.05.008 [40 CFR § 264.73] and this Permit;

I.Z.1.d. Inspection Procedures, Schedules, Logs, Records and Results for each HWMU of this Permit, as required by IDAPA 58.01.05.008 [40 CFR §§ 264.15(b)(2) and 264.73(b)(5)] and this Permit, for a period of three (3) years.

I.Z.1.e. Personnel training requirements for each HWMU of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264.16(d)] and this Permit, until closure is completed and certified by a registered, professional engineer, or for three (3) years from the date the employee left the facility.

I.Z.1.f. The site-wide Contingency Plan(s) for each HWMU of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264.53(a)] and this Permit.

I.Z.1.g. Closure Plan(s) for each HWMU of this Permit, as required by IDAPA 58.01.05.008 [40 CFR § 264.112(a)] and this Permit.

I.Z.2. Documents, as specified by this Permit, may be maintained at INTEC records storage, records storage in Idaho Falls, and/or Electronic Document Management System (EDMS) Records Vault in a readily retrievable manner.

PERMIT - MODULE II
General Facility Conditions

MODULE II - GENERAL FACILITY CONDITIONS

II.A. DESIGN AND OPERATION OF FACILITY

II.A.1. The Permittee shall maintain and operate all Hazardous Waste Management Units on the INL to minimize the possibility of a fire, explosion, or any unplanned, sudden or non-sudden release of hazardous/mixed waste/debris or hazardous constituents to the air, soil, ground water, or surface water which could threaten human health and/or the environment.

II.A.2. The Permittee shall construct and/or maintain all HWMUs in accordance with the approved designs, specifications, and maintenance schedules that are included as Attachments 1 through 8 of this Permit. Minor deviations from the approved designs or specifications, necessary to accommodate proper construction and the substitution of equivalent or superior materials or equipment, shall be noted on the as-built drawings, and the rationale for those deviations shall be provided in narrative form. After completion of construction of each Hazardous Waste Management Unit, the Permittee shall submit final as-built drawings and the narrative report to the Director as part of the construction certification documentation specified in Permit Condition I.R.

II.A.3. The Permittee shall comply with all applicable requirements of the Land Disposal Restrictions (LDR) of IDAPA 58.01.05.011 [40 CFR Part 268] or the INL Site Treatment Plan (STP), as applicable and amended. Storage of mixed waste at INL, pending completion of LDR requirements pursuant to the STP, shall be considered in compliance with RCRA and HWMA requirements.

II.B. RECEIPT OF OFF-SITE HAZARDOUS WASTE

II.B.1. The Permittee shall not receive mixed waste generated off-site into the CSSF.

II.C. WASTE ANALYSIS PLAN

II.C.1. The Permittee shall comply with the procedures and requirements of the Waste Analysis Plan for the facility, in accordance with IDAPA 58.01.05.008 and 58.01.05.011 [40 CFR §§ 264.13 and 268.7] and Attachment 2 of this Permit, and as follows:

II.C.2. The Permittee shall collect and analyze representative samples of waste, in accordance with IDAPA 58.01.05.005, 58.01.05.008, and 58.01.05.011 [40 CFR Part 261, Appendix I and 40 CFR §§ 264.13(a) and 268.7] and Permit Condition I.O.3, as specified in Attachment 2 of this Permit.

II.C.3. The Permittee shall perform the analysis of each waste stream in accordance with the latest edition of *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846* (prevailing edition), *Standard Methods of Wastewater Analysis* (prevailing edition), or other or equivalent methods approved by the Director in accordance with Permit Condition I.O.4. of this Permit. At a minimum, the Permittee shall maintain proper functional instruments, use approved sampling and analytical methods, verify the validity

of sampling and analytical procedures, and perform correct calculations. If the Permittee uses a contract laboratory to perform analyses, the Permittee shall notify the laboratory in writing of the waste analysis conditions it is to meet in order that waste analysis conditions of the Permit are met.

II.C.4. The Permittee shall document the results of all waste analyses in the Facility Operating Records, in accordance with Permit Conditions I.Z.1.b. and II.J. of this Permit.

II.D. SECURITY

The Permittee shall comply with the Security Provisions of IDAPA 58.01.05.008 [40 CFR § 264.14] and the INL site-specific, security measures, as described in Attachment 3 of this Permit.

II.E. INSPECTION PLAN

The Permittee shall comply with Inspection Schedules and Logs included in Attachment 4 of this Permit. The Permittee shall comply with the inspection provisions of IDAPA 58.01.05.008 [40 CFR § 264.15], insomuch as ALARA concerns allow and as follows:

II.E.1. The Permittee shall maintain the inspection records and results, in accordance with Permit Condition I.Z.1.d. The Permittee shall record inspections on the appropriate inspection form(s) (examples are provided in Attachment 4 of this Permit) as specified in IDAPA 58.01.05.008 [40 CFR § 264.15(d)].

II.E.2. The Permittee shall record on the appropriate Inspection forms (required by Permit Condition II.E.1) as specified in IDAPA 58.01.05.008 [40 CFR § 264.15(d)]. At a minimum, the following shall be recorded:

- The date and time of the inspection;
- The name of the inspector;
- A notation of the observations made; and
- The date and nature of any repairs or other remedial actions.

II.E.3. The Permittee shall remedy (in accessible areas), as required by IDAPA 58.01.05.008 [40 CFR § 264.15(c)], any deterioration or malfunction discovered by an inspection.

II.E.3.a. The Permittee shall, for areas where deterioration or malfunction is discovered by an inspection, and is not accessible due to ALARA concerns, provide a verbal notification to the Director within twenty-four (24) hours. In addition, a written notification shall be provided within fifteen (15) days, and include the following information:

- The date the deterioration or malfunction was discovered
- The extent of the deterioration or malfunction
- An estimation of mixed wastes released (if any)

- Estimated time schedule to submit a permit modification addressing areas of the permit affected by the deterioration or malfunction (i.e. inspections, contingency plan, closure plan, training etc.)

II.E.4. The Permittee shall retain the Inspection forms required by Permit Condition II.E.1, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.73(b)(5)] and Permit Condition I.Z.1.d.

II.F. TRAINING PLAN

II.F.1. The Permittee shall comply with the Personnel Training Plan, included in Attachment 5 of this Permit and in accordance with IDAPA 58.01.05.008 [40 CFR § 264.16], until each HWMU is fully closed and certified.

II.F.2. The Permittee shall ensure that all personnel who handle mixed waste are trained in mixed waste management, safety, and emergency procedures, as applicable to their job description, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.16 (a)], and the Personnel Training Plan described above.

II.F.3. The Permittee shall maintain the Personnel Training Plan in Attachment 5 of this Permit and documentation of personnel training received, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.16(e)] and Permit Condition I.Z.1.e. of this Permit.

II.G. PREPAREDNESS AND PREVENTION

II.G.1. The Permittee shall operate each HWMU so as to minimize the possibility of a fire, explosion, or sudden or non-sudden releases to the air or soil that could threaten human health or the environment, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.31] and Attachment 6 of this Permit.

II.G.2. The Permittee, at a minimum, shall perform preventative maintenance and repair of the facility emergency equipment, safety devices, and miscellaneous equipment included in the attachments of this Permit, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.33] and the manufacturer's specifications. The Permittee shall maintain records of these preventative maintenance and repair activities on this equipment and schedules, reflecting minimum and planned performance of these preventative maintenance activities in the Operating Record at the facility, in accordance with Permit Condition I.Z.1.

II.G.3. The Permittee shall maintain access to the communications and alarm systems, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.34] and Attachment 6 of this Permit.

II.G.4. The Permittee must maintain each vault and tank system in a dry condition.

II.G.5. The Permittee shall maintain arrangements with state and local authorities, as required by IDAPA 58.01.05.008 [40 CFR § 264.37] and Attachment 7 of this Permit. If state or local officials refuse to enter into preparedness and prevention arrangements with the

Permittee for a given HWMU, the Permittee must document this refusal in the Operating Record for the excluded unit.

II.H. CONTINGENCY PLAN

Subject to Department concurrence ALARA concerns may necessitate deviation from the following Contingency Plan requirements.

II.H.1. The Permittee shall comply with the Contingency Plan provisions of IDAPA 58.01.05.008 [40 CFR 264 Subpart D, Contingency Plan and Emergency Procedures] as modified by the Contingency Plan in Attachment 7 and as follows:

II.H.2. The Permittee shall comply with the Contingency Plan included in Attachment 7 of this Permit.

II.H.3. The Permittee shall review and amend, as necessary, the Contingency Plan, within fourteen (14) calendar days of the following events:

II.H.3.a. This Permit is revised;

II.H.3.b. The plan fails in an emergency;

II.H.3.c. The Permittee changes the facility design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of mixed waste or mixed waste constituents, or changes the response necessary in an emergency;

II.H.3.d. The list of emergency coordinators changes;

II.H.3.e. The list of emergency equipment changes; or

II.H.3.f. There is a release of calcine from the bins to the vault to address the increased potential for exposure and release.

II.H.4. The Permittee shall assure that a trained Emergency Coordinator or equivalent is available at all times in case of an emergency, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.55].

II.H.5. The Permittee shall submit a copy of the Contingency Plan, and all revisions to the plan, to all local police departments, fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.53(b)].

II.H.6. The point of contact for reporting emergencies to the State of Idaho shall be the State of Idaho Communications Center at (800) 632-8000 or (208) 846-7610, and Fax number (208) 846-7620

II.H.7. The Permittee shall document in the Facility Operating Record the time, date, and details of any incident that requires implementing the Contingency Plan. Within fifteen

(15) days after the incident, the Permittee shall submit a written report on the incident to the Director, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.56(j)] and Attachment 7 of this Permit. Said report shall include, at a minimum, the items in Permit Condition I.T.3. of this Permit.

II.I. MANIFEST SYSTEM

Not applicable to CSSF.

II.J. RECORD KEEPING AND REPORTING

In addition to the record keeping and reporting requirements specified elsewhere in this Permit, the Permittee shall comply with the following:

II.J.1. The Permittee shall maintain a written Operating Record at the INTEC Facility, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.73(a)], for all records identified in IDAPA 58.01.05.008 [40 CFR §§ 264.73(b)(1) through (b)(16)], as modified by Permit Condition I.Z.1.c.

II.J.2. The Permittee shall, by March 1 of each year, document in the Operating Record a Waste Minimization Certification, pursuant to IDAPA 58.01.05.008 [40 CFR § 264.73(b)(9)], that the Permittee has a program in place to reduce the volume and toxicity of hazardous waste that he generates, to the degree determined by the Permittee to be economically practicable; and the proposed method of treatment, storage, or disposal is the most practicable method currently available to the Permittee, which minimizes the present and future threat to human health and the environment.

II.J.3. The Permittee shall, by March 1 of each even numbered year, submit to the Director, a biennial report covering the facility activities pursuant to IDAPA 58.01.05.008 [40 CFR § 264.75(a) through (j)]. The report shall address the entire INL, unless otherwise approved by the DEQ.

II.J.4. The Permittee shall submit a biennial report to the Director describing all efforts to remove and dispose the calcine currently stored in CSSF. This report is due two years after the Permit effective date and every two years thereafter.

II.J.5. All reports, notifications, applications, or other materials required to be submitted to the Director shall be submitted in accordance with Permit Conditions I.W. and I.Y. of this Permit.

II.K. COMPLIANCE SCHEDULE

II.K.1. The Permittee shall review and amend, as necessary, the Contingency Plans, within sixty (60) calendar days of obtaining new information concerning the handling of the calcined wastes.

II.K.2 Within thirty (30) days after a catastrophic failure of a bin, the Permittee shall provide DEQ a schedule outlining all actions to be taken to monitor the vaults effectiveness preventing the calcine from entering the environment. This schedule shall include but is not limited to additional permit modifications, the addition of monitoring equipment for surrounding soils, potential for removal etc.

II.L. CLOSURE

II.L.1. The Permittee shall meet the general closure performance standard, as specified in IDAPA 58.01.05.008 [40 CFR § 264.111] and Attachment 8, during partial and/or final closure of the CSSF units.

II.L.2. The Permittee shall perform a hazardous waste determination on all solid waste generated during closure including, but not limited to, contaminated process equipment, building components, tanks and ancillary equipment, scrap metal, etc., in accordance with IDAPA 58.01.05.006 [40 CFR § 262.11] and Attachment 2 of this Permit.

II.L.3. The Permittee shall amend the Closure Plan, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.112(c)] and Attachment 8 of this Permit.

II.M. EQUIVALENT INFORMATION

II.M.1. If administrative information (such as names, phone numbers, addresses) are specified in this Permit, the Permittee is hereby authorized to revise said lists provided the substitute has completed all requisite training prior to assuming responsibility. Such administrative changes shall not be considered a modification of this Permit and the change shall be documented in the administrative record. The format of tables, forms, and figures are not subject to the requirements of this Permit and may be revised at the Permittee's discretion.

Equipment replacement/maintenance or upgrade with functionally equivalent components (e.g., valves, pump, controls, etc.), which do not require a change to the permit conditions, permit attachments, or drawings, will be completed and documented under the work control process as maintenance activities under Permit Condition II.A.1., and do not require a modification of the permit.

II.M.2. If the Department determines that the substitution was not equivalent or superior to the original, it will notify the Permittee that the Permittee's claim of equivalency has been denied, the reasons for the denial, and that the original material or equipment must be used. If the product substitution is denied, the Permittee shall comply with the original approved product specification, find an acceptable substitution, or apply for a permit modification, in accordance with Permit Condition I.D.4.

II.N. CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE

The Permittee, as a federal facility, is exempt from the closure cost estimate and financial assurance requirements, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.140(c)].

II.O. LIABILITY REQUIREMENTS

The Permittee, as a federal facility, is exempt from the liability coverage for sudden and accidental occurrence requirements, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.140(c)].

MODULE III - TANK SYSTEM STORAGE

III.A. PERMITTED TANK SYSTEM STORAGE AREAS

Subject to the terms of this Permit, the Permittee may store hazardous wastes, specified in Permit Condition III.B of this Permit, in the following hazardous waste Storage Tank Systems, located and operated as indicated in Attachment 1 and this Permit.

III.A.1.

CSSF #1	**VAULT # CPP-741**
PROCESS CODES: S02	
DESCRIPTION:	Bin Set #1 contains four sets of three storage bins in an underground rectangular vault. Each set of bins is made up of type 405 stainless steel bins with spaces between each section. A carbon steel shell encloses the outermost bin with an air space between the bin and the shell. Each composite bin consists of two 20ft tall annular tanks and one 25ft tall center cylindrical tank.
TOTAL CAPACITY:	235m³
NOTES:	This unit was built in 1959. Last waste was added in 1964. This bin set only received wastes from the Waste Calcining Facility (WCF).

CSSF #2	**VAULT #**	**CPP-742**
PROCESS CODES: S02		
DESCRIPTION:	Bin Set #2 contains 7 bins in a predominantly below ground level earthen covered cylindrical concrete vault. Six of the bins form a circle the seventh is in the center. Each bin is approximately 42ft (40’ or 42' 6") tall and 12ft diameter and is constructed of 304 stainless steel.	
TOTAL CAPACITY:	895m³	
NOTES:	This unit was built in 1965. Last waste was added in 1972. Samples were removed from here in 1978. This bin set only received wastes from the WCF.	

CSSF #3	**VAULT #**	**CPP-746**
PROCESS CODES: S02		
DESCRIPTION:	Bin Set #3 contains 7 bins in a predominantly below ground level earthen covered cylindrical concrete vault. Six of the bins form a circle the seventh is in the center. The six outer bins are 53ft tall and 12ft diameter, the center bin is 61ft tall and 12ft diameter. Each bin is constructed of 304 stainless steel.	
TOTAL CAPACITY:	1133m³	
NOTES:	This unit was built in 1969. Last waste was added in 1981. This bin set only received wastes from the WCF.	

CSSF #4		**VAULT #**	**CPP-760**
PROCESS CODES:	**S02**		
DESCRIPTION:	Bin Set #4 contains 3 bins in a partially below ground level cylindrical concrete vault. The bins are 55ft tall and 12ft diameter and are constructed of 304L stainless steel.		
TOTAL CAPACITY:	502m³		
NOTES:	This unit was built in 1976. Last waste was added in 1983. This bin set only received wastes from the New Waste Calcining Facility (NWCF).		

CSSF #5		**VAULT #**	**CPP-765**
PROCESS CODES:	**S02**		
DESCRIPTION:	Bin Set #5 contains 7 bins in a cylindrical concrete vault 1/2 below ground level. Six of the bins form a circle the seventh is in the center. These tanks are designed with open interior annulus. The bins are constructed of 304L stainless steel and are 50ft tall with a 12ft outer diameter and an 4 ft inner diameter.		
TOTAL CAPACITY:	1025m³		
NOTES:	This unit was built in 1978. Last waste was added in 1992. This bin set only received wastes from the NWCF.		

CSSF #6		**VAULT #**	**CPP-791**
PROCESS CODES:	**S02**		
DESCRIPTION:	Bin Set #6 contains 7 bins in a cylindrical concrete vault 1/2 below ground level. Six of the bins form a circle the seventh is in the middle. These 304L stainless steel tanks are designed with open interior annulus. The bins range in height from 67' 11.5" to 68' tall with outer diameter ranging from 13' 5" to 13' 6" and 5ft inner diameter.		
TOTAL CAPACITY:	1563m³		
NOTES:	This unit was built in 1980. Last waste was added in May 2000. This bin set only received wastes from the NWCF. The unit is also permitted to receive future waste transfers from other CSSF HWMUs.		

CSSF #7		**VAULT #**	**CPP-795**
PROCESS CODES:	**S02**		
DESCRIPTION:	Bin Set #7 contains 7 bins in a cylindrical concrete vault 1/2 below ground level. Six of the bins form a circle the seventh is in the middle. These 304L stainless steel tanks are designed with open interior annulus. The bins are 68ft tall with a 13.5ft outer diameter and 1ft inner diameter.		
TOTAL CAPACITY:	1784m³		
NOTES:	This unit was built in 1985. This bin set is currently empty and will be used for comparative vault and tank assessments and structural integrity. The unit is also permitted to receive future waste transfers from other CSSF HWMUs.		

III.B. PERMITTED AND PROHIBITED WASTE

The Permittee shall not store hazardous waste that is not identified in Permit Condition III.B.1 of this Permit. The Permittee may store mixed wastes in tanks, subject to the terms of this Permit and as follows:

III.B.1.

CSSF # 1	
Allowed Waste Types	Calcine from the WCF only
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	235m³
Tank construction material	405 Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Rectangular reinforced concrete 26’ x 26' x 40' high on a 2' concrete slab. The roof consists of three concrete panels

CSSF # 2	
Allowed Waste Types	Calcine from the WCF only
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	895m³
Tank construction material	304 Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 2ft thick reinforced concrete walls 50' diameter and 62' high on a 3' to 5' concrete slab. The roof is large pre-cast T beams overlain with a poured concrete slab.

CSSF # 3	
Allowed Waste Types	Calcine from the WCF only
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	1133m³
Tank construction material	304 Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 2ft thick reinforced concrete walls 50' diameter and 67' high on a 3' to 5' concrete slab. The roof is large T pre-cast beams overlain with a poured concrete slab.

CSSF # 4	
Allowed Waste Types	Calcine from the NWCF only
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	502m³
Tank construction material	304L Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 2ft to 3.5ft thick reinforced concrete walls 36' diameter and 70' high on a 4' 6" concrete slab. The roof is composed of pre-cast reinforced concrete beams overlain with a poured concrete slab.

CSSF # 5	
Allowed Waste Types	Calcine from the NWCF only
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	1025m³
Tank construction material	304L Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 4ft thick reinforced concrete walls 55' diameter and 82' high on a 5' concrete slab. The roof is overlain with a poured concrete slab supported by pre-cast reinforced concrete T beams set on the vault walls.

CSSF # 6	
Allowed Waste Types	Calcine generated at INTEC
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	1563m³
Tank construction material	304L Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 4ft thick reinforced concrete walls 52' diameter and 93' high on a 6' 6" concrete slab. The roof is composed of pre-cast reinforced concrete panels overlain with a poured concrete slab.

CSSF # 7	
Allowed Waste Types	Calcine generated at INTEC
Hazardous Waste Codes	D004, D005, D006, D007, D008, D009, D010, D011
Process Codes	S02
Maximum Volume	1784m³
Tank construction material	304L Stainless steel plate
Activities Allowed	Storage of dry granular mixed waste only
Vault Description	Cylindrical, 4ft thick 56' diameter x 94' high reinforced concrete walls on a 6' 6" thick concrete slab. The roof is composed of pre-cast reinforced concrete panels overlain with a poured concrete slab.

III.C. VAULT SYSTEMS

The Permittee shall operate and maintain the Vaults that are capable of detecting and collecting releases, and which prevent any migration of waste to the soil, groundwater, or surface water during use of the tank systems.

III.D. TANKS AND TANK SYSTEM INSTALLATION

III.D.1. In accordance with IDAPA 58.01.05.008 [40 CFR § 264.192(b)and(g)], the Permittee shall obtain, and keep on file at the INTEC, written statements from a qualified, installation inspector or qualified, registered professional engineer attesting that proper installation procedures, for all tanks and tank systems, were used.

III.D.2. The tank system installation inspection(s) required by Permit Condition III.D.1. of this Permit shall include, but not be limited to, inspection of the system for the presence of any of the following items:

- Weld breaks;
- Punctures;
- Scrapes and Protective Coatings;
- Cracks;
- Corrosion; and/or
- Other Structural Damage or Inadequate Construction/Installation.

III.E. TANK SYSTEM OPERATING CONDITIONS

III.E.1. The Permittee shall prevent spills and overflows from the CSSF Tank Systems using the procedures and equipment described in Attachment 6 and this Permit.

III.E.2. The Permittee shall not place hazardous wastes or other materials in Tank Systems if they could cause any tank, its ancillary equipment, or a containment system to rupture, leak, corrode, or otherwise fail.

III.F. RESPONSE TO LEAKS OR SPILLS

III.F.1. In the event of a leak or a spill from a tank system, or if a tank system becomes unfit for continued use, the Permittee shall complete the following actions:

III.F.1.a. Determine the cause of the release.

III.F.1.b. The Permittee shall notify the Director within twenty-four (24) hours providing the information in Permit Condition I.T.

III.F.1.c. The collected material is a HWMA hazardous waste and shall be managed in accordance with all applicable requirements of IDAPA 58.01.05.006 through .008 [40 CFR Parts 262 through 264]. If the collected material is released to the environment, it may be subject to reporting under 40 CFR Part 302.

III.F.1.d. Contain visible releases to the environment. The Permittee shall immediately conduct a visual inspection of all releases to the environment and based on that inspection, complete the following:

- Prevent further migration of the leak or spill to soils or surface water, and
- Remove and properly dispose of any visible contamination of the soil or surface water.

III.F.2. The Permittee shall establish a monitoring program in accordance with Permit Condition II.K.2. for the bin set/vault involved. This shall include but not be limited to the vault system, the air systems, and all surrounding media.

III.F.3. Within ninety (90) days the Permittee shall modify the closure plan to address the additional contamination of the vault and additional monitoring systems installed.

III.G. INSPECTION SCHEDULES AND PROCEDURES

III.G.1. The Permittee shall develop and maintain a schedule and procedures for inspecting the overfill controls, in accordance with IDAPA 58.01.05.008 [40 CFR § 264.195(a)] and Attachment 4 of this Permit.

III.G.2. The Permittee shall inspect the tank systems, in accordance with the Inspection Schedule specified in Attachment 4 of this Permit, and shall comply with Permit Conditions III.G.3. and III.G.5. of this Permit, as part of those inspections.

III.G.3. The Permittee shall inspect the following (at least) once each twenty-four (24) hour operating period:

III.G.3.a. External and accessible portions of the vaults and ancillary equipment, to detect deterioration or releases of waste.

III.G.3.b. The area immediately surrounding the externally accessible portions of the piping, to detect erosion or signs of releases of hazardous waste.

III.G.3.c. Data gathered from CAMs and other monitoring and leak detection input to ensure tank systems are being operated according to design.

III.G.4. The Permittee shall document compliance with Permit Conditions III.G.3 and III.G.5 of this Permit and place this documentation in the Operating Record for the INTEC HWMA Unit, as required by Permit Conditions I.Z. and II.J. of this Permit.

III.G.5. The Permittee shall perform internal vault inspections as follows:

- The internal vault of bin sets 1 through 3, and filter vault of bin set 1 (via video camera) shall be inspected every fifth year (i.e., during calendar years 2021, 2026, etc.);
- The internal vault of bin sets 4 through 6 (via video camera) shall be inspected every fifth year (i.e., during calendar years 2017, 2022, etc.); and
- A complete inspection of bin set 7 -by entering the vault – shall be completed annually, until closure of all bin sets is completed or mixed waste has been received for storage into CSSF bin set 7.

III.G.6. The Permittee shall provide the video camera recording and a report summarizing the results within 4 months of internal vault inspection.

III.G.7. In conjunction with the report described in Permit Condition I.U., the Permittee shall provide a semi-annual report describing any earthquakes within the INL boundary that measure greater than 4.0 in magnitude on the Richter scale, as measured on the INL facility.

III.H. RECORD KEEPING AND REPORTING

III.H.1. Releases from tanks totally contained within the vault must be verbally reported to the Director, within twenty-four (24) hours of detection and shall be recorded in the Operating Record required by Permit Conditions I.Z. and II.J. of this Permit and shall include the date and time of detection of the release, tank identification, the name and title of the employee documenting the release, the size and amount of the release, and all actions taken.

III.H.2. The Permittee shall verbally report to the Director, within twenty-four (24) hours of detection, when a leak or spill from a tank system is released to a vault or the environment, in accordance with Permit Condition I.T. of this Permit.

III.H.3. In addition to complying with the requirements of Permit Condition I.T. of this Permit, within thirty (30) calendar days of detecting a release to the environment from a tank system, the Permittee shall report the following to the Director:

III.H.3.a. Likely route of migration of the release;

III.H.3.b. Characteristics of the surrounding soil (including soil composition, geology, and hydrogeology, taking into account possible climatic effects on the soil characteristics);

III.H.3.c. Results of any monitoring, sampling, or air dispersion modeling conducted in connection with the release;

III.H.3.d. Proximity of down gradient drinking water, surface water, and populated areas; and

III.H.3.e. Description of response actions taken or planned.

III.H.4. The Permittee shall obtain, and keep on file in the Operating Records as specified in Permit Conditions I.Z and II.J, the written statements by those persons required to certify the design and installation of the tank system(s), as specified in Permit Condition III.D.2. of this Permit, until the tank system is certified closed in accordance with Permit Condition II.L. of this Permit.

III.H.5. The Permittee shall document compliance with Permit Conditions III.H.2. and III.H.3. of this Permit by placing the documentation in the Operating Records for the INTEC HWMA Unit, required by Permit Condition II.J. of this Permit.

III.H.6. The Permittee shall keep on file in the Operating Record all qualified Professional Engineer certifications of major repairs (i.e., installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel) until closure of the facility in accordance with Permit Condition II.L.

III.I. SPECIAL TANK PROVISIONS FOR IGNITABLE/REACTIVE WASTES

The Permittee shall not place ignitable, reactive or incompatible waste or materials in the tank systems.

MODULE IV - CORRECTIVE ACTION

IV.A. The corrective action requirements for these facilities are addressed in the previously issued HWMA/RCRA Partial Permit for INTEC Waste Management Operations (WMO) on the INL (effective date: June 27, 2024), Module VII.

IV.B. In the event that both the FFA/CO and the Final Partial-Permit for the INTEC WMO for the Idaho National Laboratory are vacated, the Permittee shall submit a permit modification in accordance with Permit Condition I.D.4. of this Permit.

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PERMIT - TABLES

TABLES

TABLE 1	
REQUIRED SUBMITTALS and DATES	
REQUIRED SUBMITTAL/DOCUMENT	**DUE DATES**
5 year reopener (Permit Condition I.G.1)	TBD
Permit Application re-application (Permit Condition I.G.2)	December 28, 2026
Non-Compliance Report (Permit Condition I.U)	February 1 and August 1 every year
Biennial Report (Permit Condition II.J.3)	March 1 even numbered years
Calcine Disposition Biennial Report (Permit Condition II.J.4)	June 26 odd numbered years

Part A Permit Application

United States Environmental Protection Agency
RCRA SUBTITLE C SITE IDENTIFICATION FORM

1. Reason for Submittal (Select only one.)

☐	Obtaining or updating an EPA ID number for on-going regulated activities (Items 10-17 below) that will continue for a period of time.
☐	Submitting as a component of the Hazardous Waste Report for _____ (Reporting Year)
	☐ Site was a TSD facility, a reverse distributor, and/or generator of ≥ 1,000 kg of non-acute hazardous waste, > 1 kg of acute hazardous waste, or > 100 kg of acute hazardous waste spill cleanup in **one or more months of the reporting year** (or State equivalent LQG regulations)
☐	Notifying that regulated activity is no longer occurring at this Site
☐	Obtaining or updating an EPA ID number for conducting Electronic Manifest Broker activities
☑	Submitting a new or revised Part A (permit) Form **CLASS 1 PMN FOR THE CSSF HWMA/RCRA PERMIT**

2. Site EPA ID Number

I	D	4	8	9	0	0	0	8	9	5	2

3. Site Name

IDAHO NATIONAL LABORATORY

4. Site Location Address

Street Address		
City, Town, or Village **SCOVILLE**		County BUTTE, CLARK, JEFFERSON, BONNEVILLE, BINGHAM
State **IDAHO**	Country **USA**	Zip Code **83415**
Latitude **43.536237**	Longitude **-112.945169**	☐ Use Lat/Long as Primary Address

5. Site Mailing Address ☐ Same as Location Street Address

Street Address **1955 FREMONT AVENUE**		
City, Town, or Village **IDAHO FALLS**		
State **IDAHO**	Country **USA**	Zip Code **83415**

6. Site Land Type

☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

7. North American Industry Classification System (NAICS) Code(s) for the Site (at least 5-digit codes)

A. (Primary)	**92411**	C.	**336992**
B.	**54171**	D.	

8. Site Contact Person

Enter the primary site contact here and additional contacts in Appendix A.

First Name **SHELBY**	MI **L**	Last Name **GOODWIN**
Title **ENVIRONMENTAL LEAD**		
Email **GOODWISL@ID.DOE.GOV**		
Phone **208-541-0078**	Ext **N/A**	Fax **208-526-5678**
Preferred Language **ENGLISH**		

A. Site Contact Address ☐ Same as Location Address

Street Address **1955 FREMONT AVENUE**		
City, Town, or Village **IDAHO FALLS**		
State **IDAHO**	Country **USA**	Zip Code **83415**

9. Legal Owner and Operator of the Site

A. Name of Site's Legal Owner ☐ Same as Location Address

Full Name **US DEPT OF ENERGY, IDAHO OPERATIONS OFFICE**	Date Became Owner (mm/dd/yyyy) **01/01/1952**

Owner Type

☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

Street Address **1955 FREMONT AVENUE**		
City, Town, or Village **IDAHO FALLS**		
State **IDAHO**	Country **USA**	Zip Code **83415**
Email **BOSTONRD@ID.DOE.GOV**		
Phone **208-526-7300**	Ext **N/A**	Fax **208-526-5678**
Comments **N/A**		

B. Name of Site's Legal Operator ☐ Same as Location Address

Full Name **IDAHO ENVIRONMENTAL COALITION, LLC**	Date Became Operator (mm/dd/yyyy) **01/01/2022**

Operator Type

☑ Private ☐ County ☐ District ☐ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

Street Address **1580 SAWTELLE ST**		
City, Town, or Village **IDAHO FALLS**		
State **IDAHO**	Country **USA**	Zip Code **83402**
Email **DANIEL.COYNE@ICP.DOE.GOV**		
Phone **208-533-0050**	Ext **N/A**	Fax **208-533-0202**
Comments **N/A**		

10. Type of Regulated Waste Activity (at your site)

Mark "Yes" or "No" for all current activities (as of the date submitting the form); complete any additional boxes as instructed.

A. Hazardous Waste Activities

☑ Y ☐ N	1. Generator of Hazardous Waste—If "Yes", mark only one of the following—a, b, c	
☑	a. LQG	-Generates, in any calendar month, 1,000 kg/mo (2,200 lb/mo) or more of non-acute hazardous waste (includes quantities imported by importer site); or - Generates, in any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lb/mo) of acute hazardous waste; or - Generates, in any calendar month or accumulates at any time, more than 100 kg/mo (220 lb/mo) of acute hazardous spill cleanup material.
☐	b. SQG	100 to 1,000 kg/mo (220-2,200 lb/mo) of non-acute hazardous waste and no more than 1 kg (2.2 lb) of acute hazardous waste and no more than 100 kg (220 lb) of any acute hazardous spill cleanup material.
☐	c. VSQG	Less than or equal to 100 kg/mo (220 lb/mo) of non-acute hazardous waste.
☑ Y ☐ N	Is State Generator of Hazardous Waste the same as Federal— If "No", indicate State Generator Category in the space provided.	
☐ Y ☑ N	2. Short-Term Generator (generates from a short-term or one-time event and not from on-going processes). If "Yes", provide an explanation in the Comments section. *Note: If "Yes", you MUST indicate that you are a Generator of Hazardous Waste in Item 10.A.1 above.*	
☑ Y ☐ N	3. Treater, Storer or Disposer of Hazardous Waste—Note: Part B of a hazardous waste permit is required for these activities.	
☑ Y ☐ N	4. Receives Hazardous Waste from Off-site	
☐ Y ☑ N	5 Recycler of Hazardous Waste	
☐	a. Recycler who stores prior to recycling	
☐	b. Recycler who does not store prior to recycling	
☐ Y ☑ N	6. Exempt Boiler and/or Industrial Furnace—If "Yes", mark all that apply.	
☐	a. Small Quantity On-site Burner Exemption	
☐	b. Smelting, Melting, and Refining Furnace Exemption	

B. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g. D001, D003, F007, U112). Use an additional page if more spaces are needed.

SEE ITEM 18. COMMENTS (PAGE 6 OF 6)				

C. Waste Codes for State Regulated (non-Federal) Hazardous Wastes. Please list the waste codes of the State hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.

SEE ITEM 18. COMMENTS (PAGE 6 OF 6)				

11. Additional Regulated Waste Activities (NOTE: Refer to your State regulations to determine if a separate permit is required.)

A. Other Waste Activities

☑ Y ☐ N	1. Transporter of Hazardous Waste—If "Yes", mark all that apply.
☑	a. Transporter
☐	b. Transfer Facility (at your site)
☐ Y ☑ N	2. Underground Injection Control
☐ Y ☑ N	3. United States Importer of Hazardous Waste
☐ Y ☑ N	4. Recognized Trader—If "Yes", mark all that apply.
☐	a. Importer
☐	b. Exporter
☐ Y ☑ N	5. Importer/Exporter of Spent Lead-Acid Batteries (SLABs) under 40 CFR 266 Subpart G—If "Yes", mark all that apply.
☐	a. Importer
☐	b. Exporter

B. Universal Waste Activities

☑ Y ☐ N	1. Large Quantity Handler of Universal Waste (you accumulate 5,000 kg or more) - If "Yes" mark all that apply. Note: Refer to your State regulations to determine what is regulated.
☑	a. Batteries
☑	b. Pesticides
☑	c. Mercury containing equipment
☑	d. Lamps
☑	e. Aerosol Cans
☐	f. Other (specify) _____
☐	g. Other (specify) _____
☐ Y ☑ N	2. Destination Facility for Universal Waste Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities

☐ Y ☑ N	1. Used Oil Transporter—If "Yes", mark all that apply.
☐	a. Transporter
☐	b. Transfer Facility (at your site)
☐ Y ☑ N	2. Used Oil Processor and/or Re-refiner—If "Yes", mark all that apply.
☐	a. Processor
☐	b. Re-refiner
☐ Y ☑ N	3. Off-Specification Used Oil Burner
☐ Y ☑ N	4. Used Oil Fuel Marketer—If "Yes", mark all that apply.
☐	a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner
☐	b. Marketer Who First Claims the Used Oil Meets the Specifications

D. Pharmaceutical Activities

☑ Y ☐ N		1. Operating under 40 CFR Part 266, Subpart P for the management of hazardous waste pharmaceuticals—if "Yes", mark only one. Note: See the item-by-item instructions for definitions of healthcare facility and reverse distributor.
	☑	a. Healthcare Facility
	☐	b. Reverse Distributor
☐ Y ☑ N		2. Withdrawing from operating under 40 CFR Part 266, Subpart P for the management of hazardous waste pharmaceuticals. Note: You may only withdraw if you are a healthcare facility that is a VSQG for all of your hazardous waste, including hazardous waste pharmaceuticals.

12. Eligible Academic Entities with Laboratories—Notification for opting into or withdrawing from managing laboratory hazardous wastes pursuant to 40 CFR Part 262, Subpart K.

☐ Y ☑ N		A. Opting into or currently operating under 40 CFR Part 262, Subpart K for the management of hazardous wastes in laboratories— If "Yes", mark all that apply. Note: See the item-by-item instructions for definitions of types of eligible academic entities.
	☐	1. College or University
	☐	2. Teaching Hospital that is owned by or has a formal written affiliation with a college or university
	☐	3. Non-profit Institute that is owned by or has a formal written affiliation with a college or university
☐ Y ☑ N		B. Withdrawing from 40 CFR Part 262, Subpart K for the management of hazardous wastes in laboratories.

13. Episodic Generation

☐ Y ☑ N	Are you an SQG or VSQG generating hazardous waste from a planned or unplanned episodic event, lasting no more than 60 days, that moves you to a higher generator category. If "Yes", you must fill out the Addendum for Episodic Generator.

14. LQG Consolidation of VSQG Hazardous Waste

☐ Y ☑ N	Are you an LQG notifying of consolidating VSQG Hazardous Waste Under the Control of the Same Person pursuant to 40 CFR 262.17(f)? If "Yes", you must fill out the Addendum for LQG Consolidation of VSQG hazardous waste.

15. Notification of LQG Site Closure for a Central Accumulation Area (CAA) (optional) OR Entire Facility (required)

☐ Y ☑ N	LQG Site Closure of a Central Accumulation Area (CAA) or Entire Facility.
	A. ☐ Central Accumulation Area (CAA) or ☐ Entire Facility
	B. Expected closure date: _____ mm/dd/yyyy
	C. Requesting new closure date: _____ mm/dd/yyyy
	D. Date closed : _____ mm/dd/yyyy ☐ 1. In compliance with the closure performance standards 40 CFR 262.17(a)(8) ☐ 2. Not in compliance with the closure performance standards 40 CFR 262.17(a)(8)

16. Notification of Hazardous Secondary Material (HSM) Activity

☐ Y ☑ N	Are you notifying under 40 CFR 260.42 that you will begin managing, are managing, or will stop managing hazardous secondary material under 40 CFR 260.30, 40 CFR 261.4(a)(23), (24), (25), or (27)? If "Yes", you must fill out the Addendum to the Site Identification Form for Managing Hazardous Secondary Material.

17. Electronic Manifest Broker

☐ Y ☑ N	Are you notifying as a person, as defined in 40 CFR 260.10, electing to use the EPA electronic manifest system to obtain, complete, and transmit an electronic manifest under a contractual relationship with a hazardous waste generator?

18. Comments (include item number for each comment)

ITEM 10.B. See Item 7 of the Hazardous Waste Permit Part A Form
ITEM 10.C. See Item 7 of the Hazardous Waste Permit Part A Form

19. Certification 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 fines and imprisonment for knowing violations. **Note: For the RCRA Hazardous Waste Part A permit Application, all owners and operators must sign (see 40 CFR 270.10(b) and 270.11).**

Signature of legal owner, operator or authorized representative	Date (mm/dd/yyyy) 11/17/2025
Printed Name (First, Middle Initial Last) DANIEL W. COYNE	Title PROGRAM MANAGER, IEC, LLC
Email DANIEL.COYNE@ICP.DOE.GOV	

Signature of legal owner, operator or authorized representative ROBERT BOSTON Digitally signed by ROBERT BOSTON Date: 2025.12.12 06:15:06 -07'00'	Date (mm/dd/yyyy)
Printed Name (First, Middle Initial Last) ROBERT BOSTON	Title MANAGER, DOE, IDAHO OPS OFFICE
Email BOSTONRD@ID.DOE.GOV	

EPA ID Number	I	D	4	8	9	0	0	0	8	9	5	2

OMB# 2050-0024; Expires 08/31/2028

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT PART A FORM

1. Facility Permit Contact

First Name	**SHELBY**	MI	**L**	Last Name	**GOODWIN**
Title	**ENVIRONMENTAL LEAD**				
Email	**GOODWISL@ID.DOE.GOV**				
Phone	**208-541-0078**	Ext	**N/A**	Fax	**208-526-5678**

2. Facility Permit Contact Mailing Address

Street Address	**1955 FREMONT AVENUE**	
City, Town, or Village	**IDAHO FALLS**	
State **IDAHO**	Country **USA**	Zip Code **83415**

3. Facility Existence Date (mm/dd/yyyy)

1/1/1949

4. Other Environmental Permits

A. Permit Type	B. Permit Number	C. Description
R	**IDA 8900 0089 52**	**MFC (PER-116)**
R	**IDA 8900 0089 52**	**INTEC LWMS (PER-111)**
R	**IDA 8900 0089 52**	**INTEC WASTE MANAGMENT (PER-109)**
R	**IDA 8900 0089 52**	**INTEC CALCINE (PER-114)**
R	**IDA 8900 0089 52**	**INTEC POST CLOSURE (PER-112)**
		SEE PAGE 1A OF 2 FOR ADDITIONAL
		INFO SUPPLEMENT TO ITEM 4

5. Nature of Business

The Idaho National Laboratory was established in 1949 as a center where nuclear power reactors and support facilities could be built, tested, and operated. The INL site covers approximately 890 square miles and is 25 miles west of Idaho Falls, ID. For many years, the INL was the site of the largest nuclear power research and development effort in the world. During the 1970's the INL's mission broadened to include such areas a biotechnology, energy and materials research, and conservation and renewable energy. At the end of the Cold War, waste treatment and cleanup of previously contaminated sites became a priority. Today the INL is a science-based, applied engineering national laboratory dedicated to completing its waste cleanup mission and meeting the nation's environmental, energy, nuclear science and technology, and national security needs. Additionally, in 2002, it was announced that the INL will serve as the nation's leading nuclear technology center.

Supplement to Item 4. Other Environmental Permits List

STATE OF IDAHO HAZARDOUS WASTE MANAGEMENT PERMIT

(Permit Type R)

- Advanced Mixed Waste Treatment Project (AMWTP) HWMA/RCRA Partial Permit(PER-153)
- HWMA/RCRA Part A Permit Application for the INL – INTEC (Volume 1, PER-101)
- HWMA/RCRA Part B Permit Application for the INL – General Information for INL Waste Management Units (Volume 3, PER-102)

STATE OF IDAHO AIR PERMITS

PTC (Permit Number P-2020.0045)

- INL Sitewide Permit to Construct Facility and Emissions Cap

WATER PERMITS

State of Idaho Monitoring Well Permit (IDWR)

(Permit Type U)

- INL monitoring well permit applications are sent annually to the IDWR for wells (greater than 18 feet deep) to be constructed in the current calendar year. Permits are authorized by agreement between the DOE-ID and the IDWR.

State of Idaho Wastewater Permits (WRP)

(Permit Type E)

- INL Idaho Nuclear Technology and Engineering Center (INTEC) New Percolation Ponds, Reuse Permit M-130-06
- INL Materials and Fuels Complex (MFC) Industrial Waste Pond, Reuse Permit I-160-02
- INL Advanced Test Reactor (ATR) Complex Cold Waste Ponds, Reuse Permit I-161-03

Water Rights

(Permit Type E)

- INL operations use groundwater guaranteed by a Water Right between the State of Idaho and the United States Department of Energy.

6. Process Codes and Design Capacities

Line Number		A. Process Code			B. Process Design Capacity		C. Process Total Number of Units	D. Unit Name
					(1) Amount	(2) Unit of Measure		
0	1	S	0	2	1,885,595.40	G	007	See Page 2a of 2, Supplement to Item 6.

7. Description of Hazardous Wastes (Enter codes for Items 7.A, 7.C and 7.D(1))

Line No.		A. EPA Hazardous Waste No.				B. Estimated Annual Qty of Waste	C. Unit of Measure	D. Processes								
								(1) Process Codes								(2) Process Description (if code is not entered in 7.D1))
0	1	SEE ITEM 11. (COMMENTS) BELOW														

8. Map

Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all spring, rivers, and other surface water bodies in this map area. See instructions for precise requirements.

9. Facility Drawing

All existing facilities must include a scale drawing of the facility. See instructions for more detail.

10. Photographs

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

11. Comments

ITEM 7: See Supplemental Page to Item 7. [Page 2(A-1) of 2 of this Part A Permit Application]
ITEM 8: See Attachment 1 - Section B Facility Description of this Part B Permit
ITEM 9: See Attachment 1 - Sections B and D of this Part B Permit
ITEM 10: See Pages 2(TOC) through 2i of 2 of this Part A Permit

SUPPLEMENT TO ITEM 6. PROCESS CODES AND DESIGN CAPACITIES

LINE NUMBER	PROCESS TYPE UNIT NAME		PROCESS DESIGN CAPACITY
1	**S02 - CSSF TANK STORAGE includes 7 Bin Set Tanks:**		
	• Bin Set #1 (4 bins) @ 235 cubic meters		**62,087 gallons**
	• Bin Set #2 (7 bins) @ 895 cubic meters		**236,459 gallons**
	• Bin Set #3 (7 bins) @ 1,133 cubic meters		**299,338.6 gallons**
	• Bin Set #4 (3 bins) @ 502 cubic meters		**132,628.4 gallons**
	• Bin Set #5 (7 bins) @ 1,025 cubic meters		**270,805 gallons**
	• Bin Set #6 (7 bins) @ 1,563 cubic meters		**412,944.6 gallons**
	• Bin Set #7 (7 bins) @ 1,784 cubic meters		**471, 332.8 gallons**
		Line 1 Total:	**7,137** cubic meters or 1,885,595.4 gallons**

**Please note: The Uniform Conversion Factor of 264.2 was used to convert cubic meters into gallons, as published in the MERCK INDEX, Twelfth Edition. (cubic meters x 264.2 = gallons)

SUPPLEMENT TO ITEM 7. DESCRIPTION OF HAZARDOUS WASTES (ENTER CODES FOR ITEMS 7.A, 7.C AND 7 D(1))																		
Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES										
								(1) PROCESS CODES (Enter code)										(2) PROCESS DESCRIPTION (If a code is not entered in 7.D(1))
	1	D	0	0	4	8,400	T	S	0	2								CSSF #1 through CSSF #7
	2	D	0	0	5													INCLUDED WITH ABOVE
	3	D	0	0	6													INCLUDED WITH ABOVE
	4	D	0	0	7													INCLUDED WITH ABOVE
	5	D	0	0	8													INCLUDED WITH ABOVE
	6	D	0	0	9													INCLUDED WITH ABOVE
	7	D	0	1	0													INCLUDED WITH ABOVE
	8	D	0	1	1													INCLUDED WITH ABOVE
	9																	
1	0																	
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3	6																	

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY

Photo Number	Photo Description & Unit Process Code	Photo Date	Page Number
20160215_121753	CSSF, Bin Set #1. Looking at the aboveground blower/instrument building (CPP-639) and cooling air stack (CPP-732) for Bin Set #1. S02 - Tank Storage	2/15/2016	2b of 2
20160215_122205	CSSF, Bin Sets #1, #2, and #3. Looking at the earthen berm constructed around Bin Sets #1, #2, and #3 as seen from the east side. S02 - Tank Storage	2/15/2016	2c of 2
20160215_121323	CSSF, Bin Set #2. Looking at the earthen berm surrounding the aboveground portion of the vault (CPP-742) from the south. S02 - Tank Storage	2/15/2016	2d of 2
20160215_121702	CSSF, Bin Set #3. Looking at the earthen berm surrounding the aboveground portion of the vault (CPP-746). S02 - Tank Storage	2/15/2016	2e of 2
20160215_122134	CSSF, Bin Set #4. Looking at the aboveground portion of the vault structure (CPP-760), along with the instrument building (CPP-658), instrument vault (CPP-761), and cooling air stack atop of the vault structure, as seen from the south along Hemlock Street. S02 - Tank Storage	2/15/2016	2f of 2
20160215_121940	CSSF, Bin Set #5. Looking at the aboveground portion of the vault structure (CPP-765), as seen from the south-southwest along Hemlock Street. S02 - Tank Storage	2/15/2016	2g of 2
20160215_122001	CSSF, Bin Set #6. Looking at the aboveground portion of the vault structure (CPP-791), as seen from the southwest along Hemlock Street. S02 - Tank Storage	2/15/2016	2h of 2
20160215_122315	CSSF, Bin Set #7. Looking at the aboveground portion of the vault structure (CPP-795), as seen from the west along Hemlock Street. S02 - Tank Storage	2/15/2016	2i of 2

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #1. Looking at the aboveground blower/instrument building (CPP-639) and cooling air stack (CPP-732) for Bin Set #1. (The bin set vault itself is completely below grade.)

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Looking at the earthen berm constructed around Bin Sets #1, #2, and #3 as seen from the east side.

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #2. Looking at the earthen berm surrounding the aboveground portion of the vault (CPP-742) from the south.

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #3. Looking at the earthen berm surrounding the aboveground portion of the vault (CPP-746).

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #4. Looking at the aboveground portion of the vault structure (CPP-760), along with the instrument building (CPP-658), instrument vault (CPP-761), and cooling air stack atop of the vault structure, as seen from the south along Hemlock Street.

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



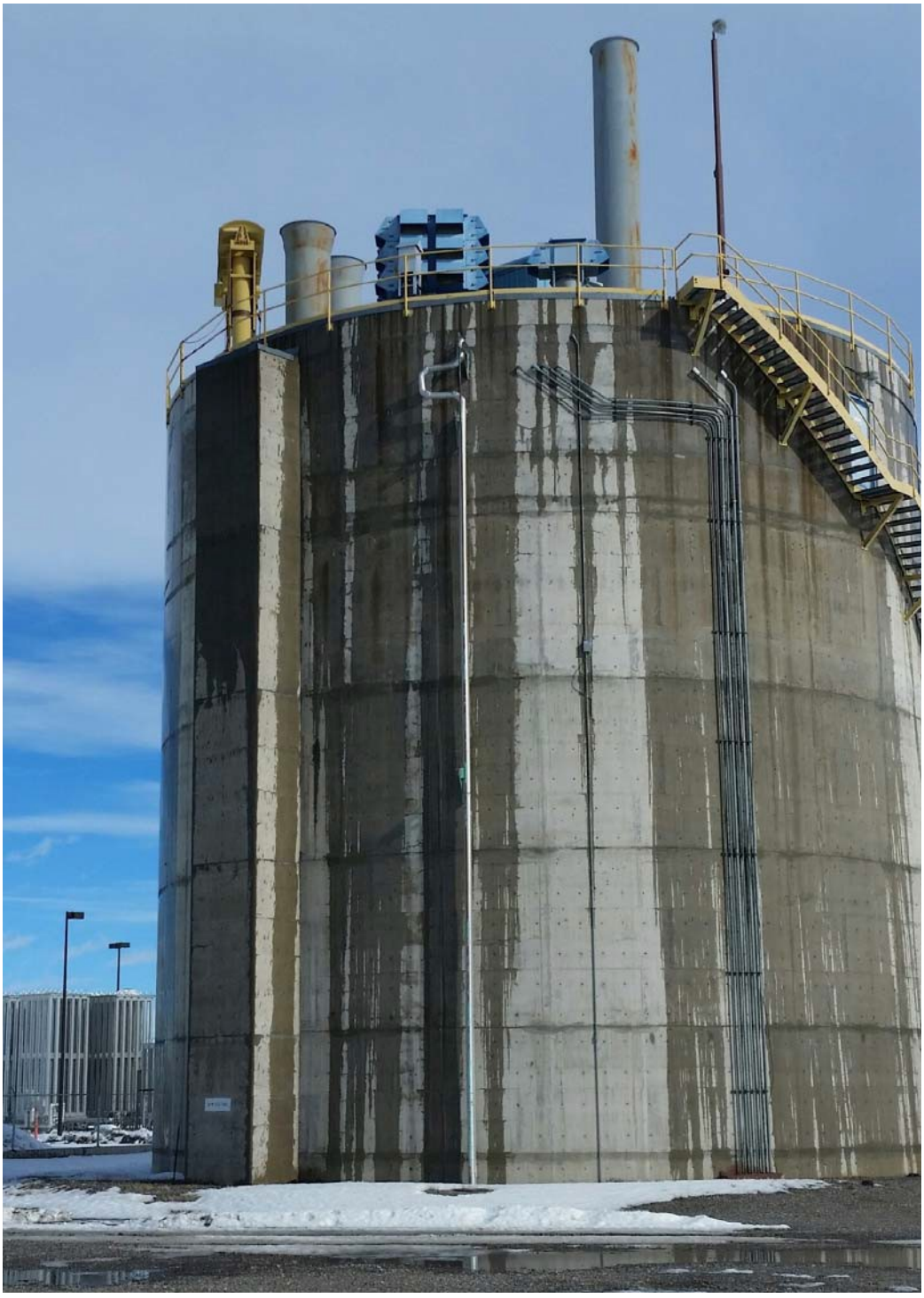
Bin Set #5. Looking at the aboveground portion of the vault structure (CPP-765), as seen from the south-southwest along Hemlock Street

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #6. Looking at the aboveground portion of the vault structure (CPP-791), as seen from the southwest along Hemlock Street.

ITEM 10. PHOTOGRAPHS
CALCINED SOLIDS STORAGE FACILITY



Bin Set #7. Looking at the aboveground portion of the vault structure (CPP-795), as seen from the west along Hemlock Street.

Attachment 1
Section B Facility Description

RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 1 - Section B
Facility Description

May 2016

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B. FACILITY DESCRIPTION

B-1. General Description [IDAPA 58.01.05.012; 40 CFR 270.14(b)(1)]

Although, the Calcined Solids Storage Facility (CSSF) bins are not currently receiving any waste, this permit reapplication allows for the continued use of the Bin Sets 1, 2, 3, 4, and 5 for storage and Bin Sets 6 and 7 for storage and to receive future waste transfers.

This Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) permit reapplication addresses storage of calcine (Process Code S02 – storage in tanks) located at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory (INL). The CSSF includes seven bin sets. The bins are functionally the same and contain calcine, which is a solid stable dry granular mixed waste. The bins are described in detail in Attachment 1 - Section D of this permit reapplication.

The INTEC is located in the south-central portion of the INL in Butte County. The location of this complex on the INL Site is shown in Exhibit B-1. The physical conditions around these buildings are typical for the INL Site, approximately 5,000 ft above mean sea level, as shown on the topographic map, Exhibit B-2. The area is relatively flat and receives little rainfall. However, poor drainage patterns can produce localized flooding during periods of rapid snowmelt and/or heavy rainfall. Due to the lack of rainfall and the poor quality of the surficial soils, the site has little agricultural value. Wind patterns are generally in a northeast/southwest axis, with some seasonal variability.

Appendix 1 of this Part B permit reapplication contains a drawing showing the principal culverts, ditches, and storm systems, and a drawing showing the sanitary waste system at the INTEC. There are no recreation areas present on or adjacent to the INTEC.

Bin Set 1 is contained in a rectangular reinforced concrete vault. Exhibit B-3 provides a cutaway view of CSSF 1. The vault is located underground and founded on bedrock. The vault is approximately 26 ft by 26 ft with a height of 40 ft. The vertical walls of the vault chamber are 2 ft 6 in. thick. Overlying the base slab is a 2-ft-thick concrete foundation that supports the bin radial support beams. The roof consists of three panels, two of which span between the vault walls and pre-cast beams; the third panel spans between the pre-cast beams.

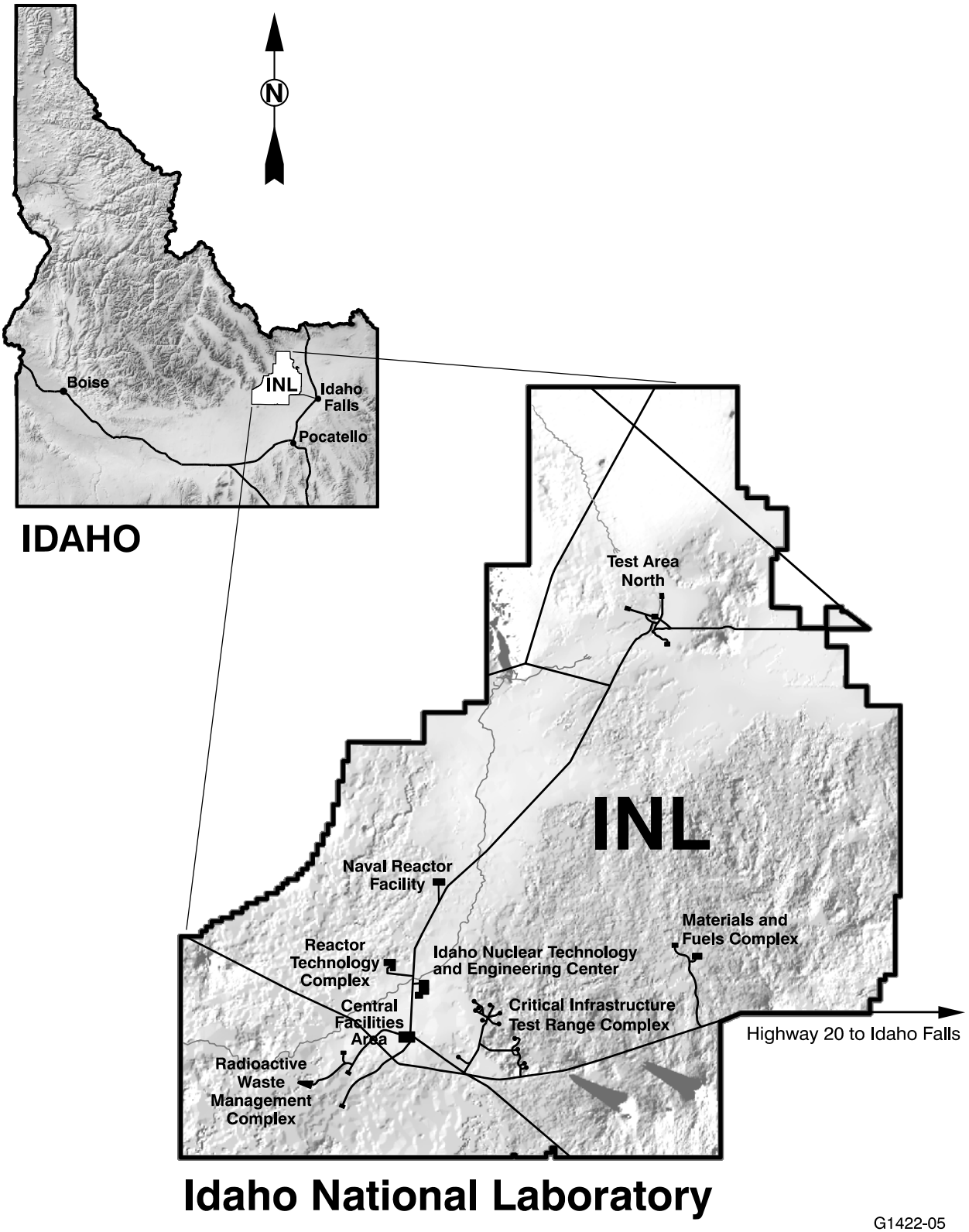


Exhibit B-1. Location of the INTEC on the INL.

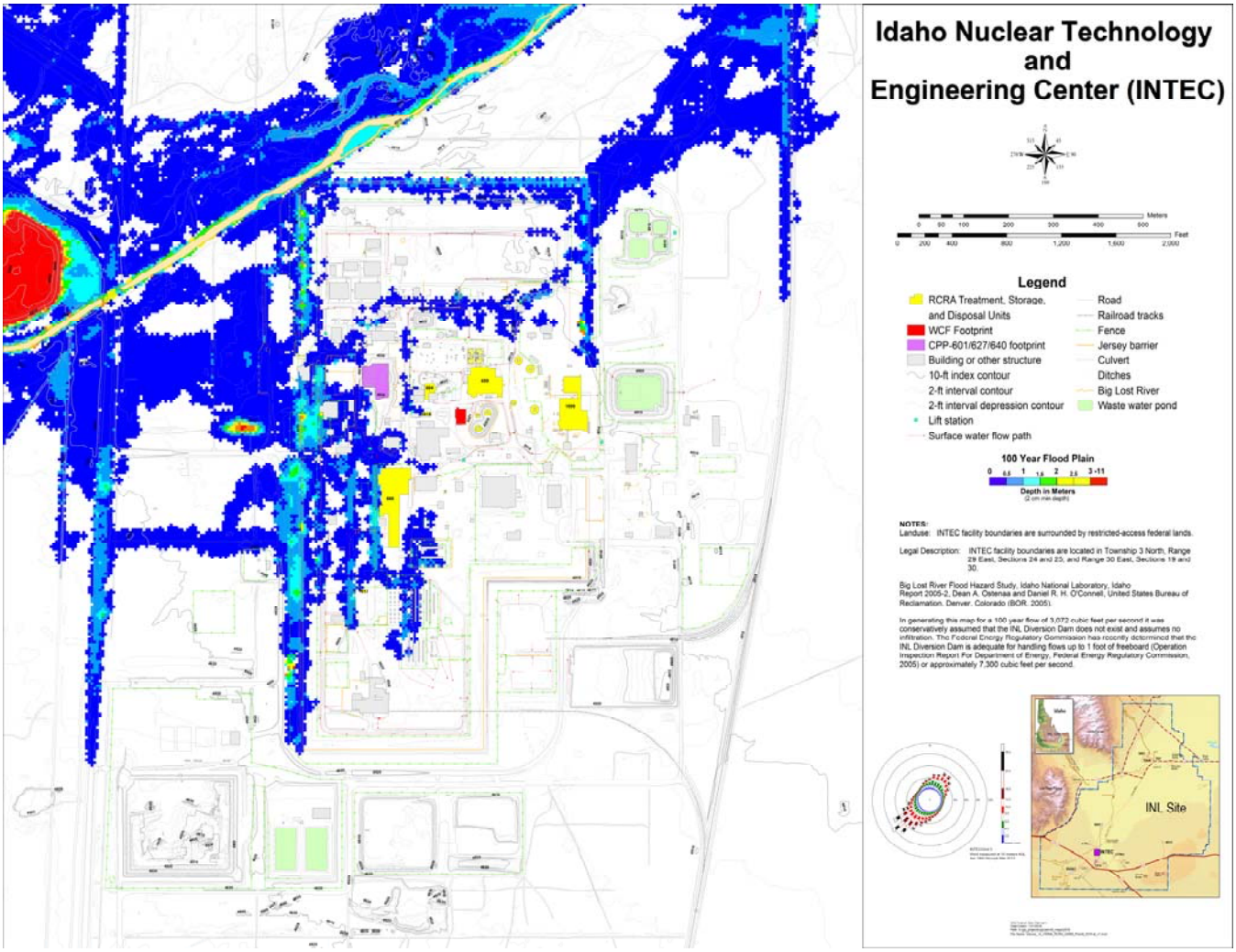


Exhibit B-2. Topographic Map of the INTEC

Bin Set 2 is a cylindrical, reinforced concrete vault that is founded on bedrock and encases the seven bins. Exhibit B-3 provides a cutaway view of CSSF 2. The vault is located predominantly underground, with earth banked up against the aboveground portion. The vault is 62 ft high with a 50-ft diameter. The vault walls are constructed of reinforced concrete measuring 2 ft thick. The concrete floor slab varies in thickness from 3 to 5 ft. The roof is composed of large pre-cast T-beams overlain with a field-poured concrete slab.

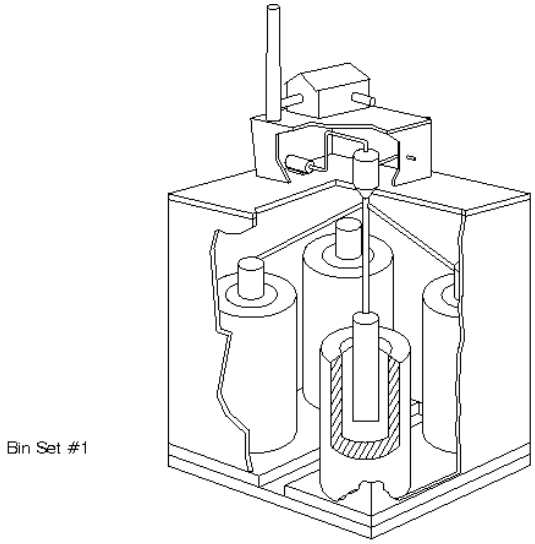
Bin Set 3 is contained in a vault that is 67 ft high with a 50-ft diameter and founded on bedrock. Exhibit B-3 provides a cutaway view of CSSF 3. The vault is located predominantly underground with earth banked up against the aboveground portion. The vault walls are constructed of reinforced concrete measuring 2 ft thick. The concrete floor slab varies in thickness from 3 ft to 5 ft. The roof is composed of large pre-cast T beams overlain with a field-poured concrete slab.

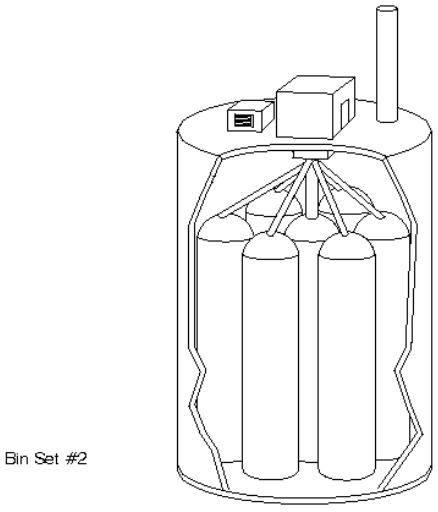
Bin Set 4 is contained in a cylindrical, reinforced concrete vault that is located partially underground and founded on bedrock. Exhibit B-4 provides a cutaway view of CSSF 4. The vault is approximately 70 ft high and 36 ft in diameter. The vault floor is a concrete slab measuring 4 ft 6 in. thick. Vault walls are from 2 ft to 3 ft 6 in. thick. The roof is composed of pre-cast, reinforced concrete beams overlain with a field-poured concrete slab.

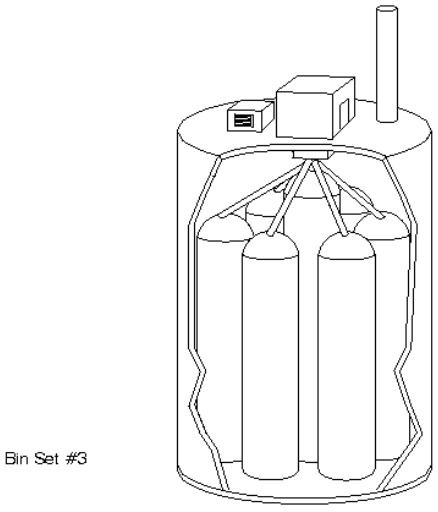
Bin Set 5 is encased in a cylindrical, reinforced concrete vault that is founded on bedrock. Exhibit B-4 provides a cutaway view of CSSF 5. Approximately half of the vault is located below ground level. The vault is approximately 82 ft high and 55 ft in diameter. The vault floor is a concrete slab measuring 5 ft thick. The vault walls are 4 ft thick. The vault roof is overlain with a field-poured concrete slab supported by pre-cast, reinforced concrete T-beams set on the vault walls.

Bin Set 6 is contained in a cylindrical, reinforced concrete vault that is founded on bedrock. Exhibit B-4 provides a cutaway view of CSSF 6. Approximately half of the vault is located below ground level. The vault is approximately 93 ft high and 52 ft in diameter. The vault floor is a concrete slab measuring 6 ft 6 in. thick. The vault walls are 4 ft thick. Pre-cast, reinforced concrete panel forms support the vault roof that is overlain with a field-poured concrete slab.

Bin Set 7 is contained in a cylindrical, reinforced concrete vault that is founded on bedrock. Exhibit B-4 provides a cutaway view of CSSF 7. Approximately half of the vault is located below ground level. The vault is approximately 94 ft high and 56 ft in diameter. The vault floor is a concrete slab measuring 6 ft 6 in. thick. The vault walls are 4 ft thick. Pre-cast, reinforced concrete panel forms support the vault roof that is overlain with a field-poured concrete slab.

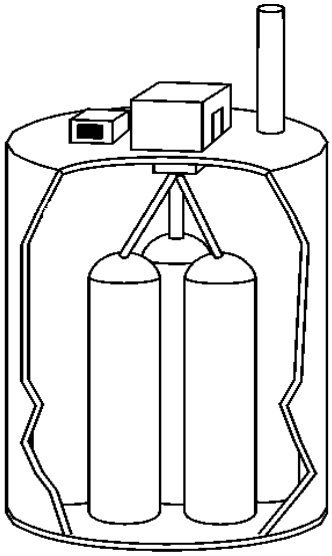




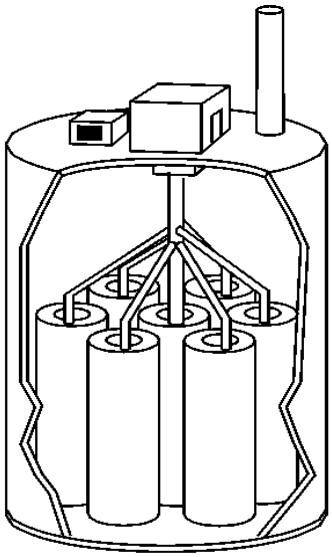


ICPP-A-16027
(3-94)

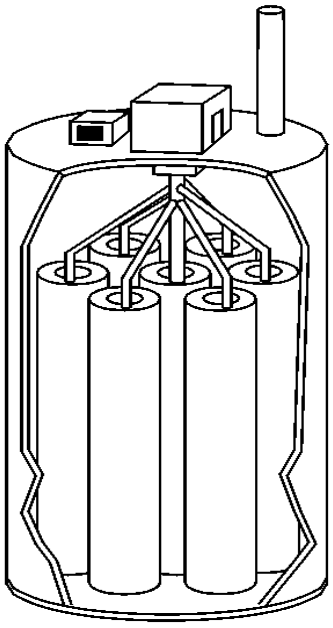
Exhibit B-3. Cut-away view of CSSFs 1, 2, and 3.



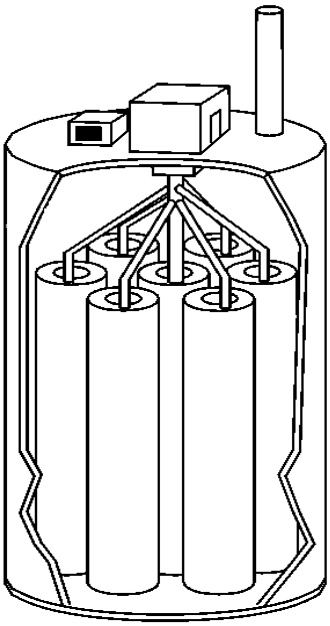
Bin Set #4



Bin Set #5



Bin Set #6



Bin Set #7

ICPP-A-16115
(3-94)

Exhibit B-4. Cut-away view of CSSFs 4, 5, 6, and 7.

Attachment 1
Section D Facility Description

RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 1 - Section D
Process Description

May 2016

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D. PROCESS INFORMATION

This permit reapplication focuses on the CSSF, also known as bin sets, located at the Idaho Nuclear Technology and Engineering Center (INTEC) on the Idaho National Laboratory (INL). The CSSF includes Bin Sets 1, 2, 3, 4, 5, 6, and 7 located in the northeast quadrant of the INTEC. CSSF Bin Set 1 contains four stainless-steel composite bins. CSSF Bin Sets 2–7 consist of either three or seven stainless-steel storage bins. All CSSF bin sets are located in underground or partially underground concrete vaults. The CSSF bins are permitted for tank storage (S02) under Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 (40 CFR 264, Subpart J) requirements.

Although the Calcined Solids Storage Facility (CSSF) bins are not currently receiving any waste, This permit reapplication allows for the continued use of Bin Sets 1, 2, 3, 4, and 5 for storage and Bin Sets 6 and 7 for storage and to receive future waste transfers.

From December 1963 to June 2000, the calciners at the INTEC were used to convert approximately 7,920,000 gal of liquid mixed waste into approximately 155,600 ft^3 of granular calcine solids. In the calciner processes liquid wastes were injected into a high-temperature (400 to 600° C) air-fluidized bed of granular solids. The liquid portion of the waste evaporated and the solids adhered to the granular material-producing calcine. Exhibit D-1 provides a diagram of the typical calciner process flow. Calcined solids were pneumatically transferred from the calciner facilities to the CSSF via air transport lines. In the CSSF, the solids are stored in stainless-steel bins located in underground or partially underground concrete vaults to isolate them from the environment. Exhibit D-2 provides the calcine solids flow path from the Waste Calcining Facility (WCF) to the CSSF. Exhibit D-3 provides the calcine solids flow paths from the New Waste Calcining Facility (NWCF) to the CSSF.

D-2. Tank Systems

The following identifies the CSSF tanks, ancillary equipment, and boundaries of the CSSF. Each individual bin set and ancillary equipment meets the Hazardous Waste Management Act (HWMA)/RCRA definition of a tank system, although no free liquids are stored in the CSSF. The bin sets are located inside underground or partially underground concrete vaults intended to satisfy radiation protection standards, not RCRA-defined secondary containment.

- CSSF 1 consists of four composite tank groups, VES-WCS-115-1 through VES-WCS-115-4, and Distributor Pipe VES-WCS-3083, located in Vault CPP-741 (see Drawings 106576 and 106577, Appendix 1).

- CSSF 2 consists of seven tanks, VES-WCS-136-1 through VES-WCS-136-7, and Distributor Pipe VES-WCS-137, located in Vault CPP-742 (see Drawings 118862 and 118871, Appendix 1).

- CSSF 3 consists of seven tanks, VES-WCS-140-1 through VES-WCS-140-7 (VES-WCS-140-7 was originally designated as VES-WCS-139 and later changed), and Distributor Pipe VES-WCS-141, located in Vault CPP-746 (see Drawings 153510 and 154129, Appendix 1).

- CSSF 4 consists of three tanks, VES-WS4-142 through VES-WS4-144, and Distributor Pipe VES-WS4-145, located in Vault CPP-760 (see Drawings 155750 and 157798, Appendix 1).

- CSSF 5 consists of seven tanks, VES-WS5-146 through VES-WS5-152, and Distributor Pipe VES-WS5-153, located in Vault CPP-765 (see Drawings 158491 and 158510, Appendix 1).

- CSSF 6 consists of seven tanks, VES-WS6-154 through VES-WS6-160, and Distributor Pipe VES-WS6-161, located in Vault CPP-791 (see Drawings 160283 and 161425, Appendix 1).

- CSSF 7 consists of seven tanks, VES-WS7-162 through VES-WS7-168, and Distributor Pipe VES-WS7-169, located in Vault CPP-795 (see Drawing 099162 and 165772, Appendix 1).

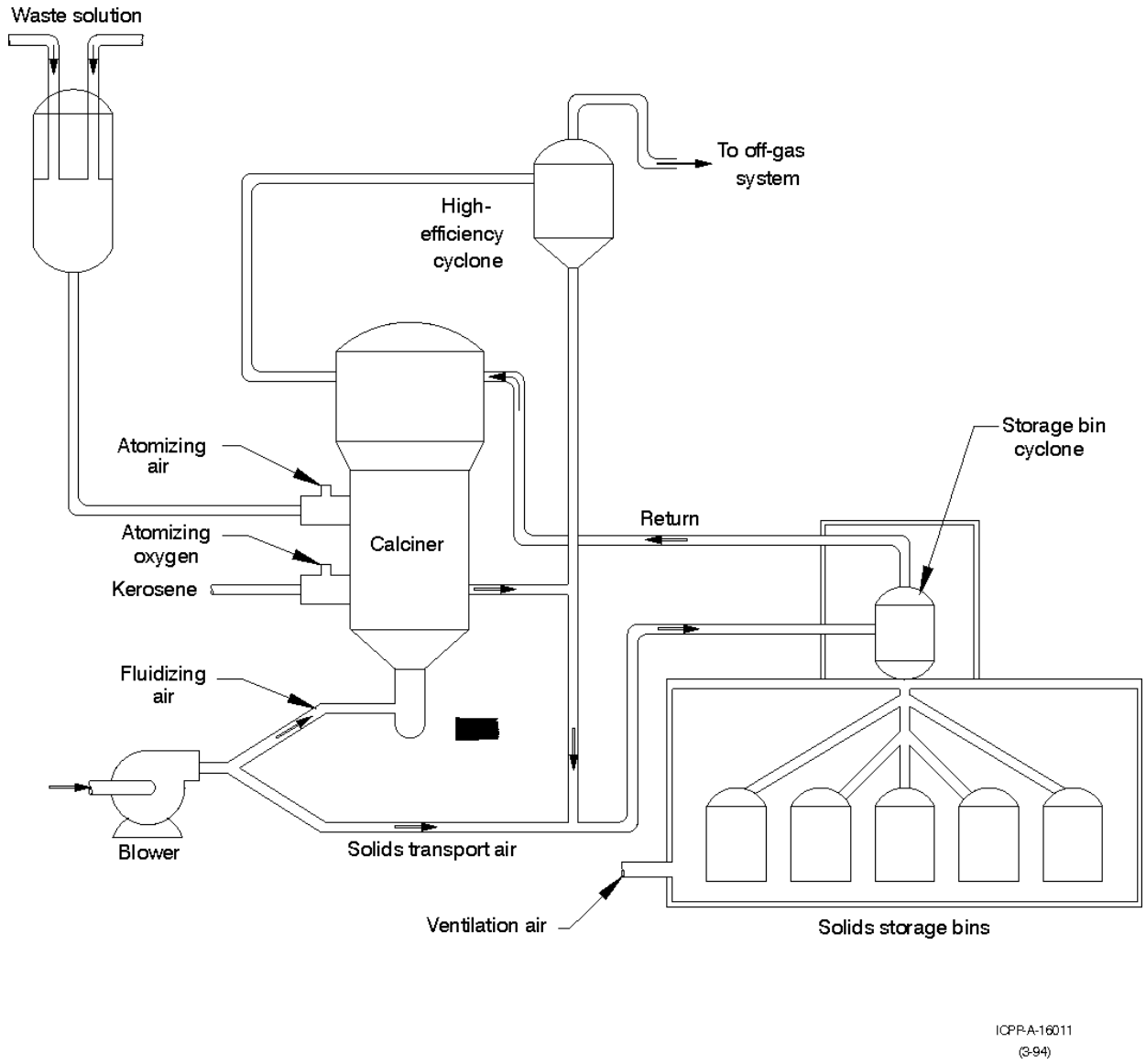


Exhibit D-1. Typical calciner process flow.

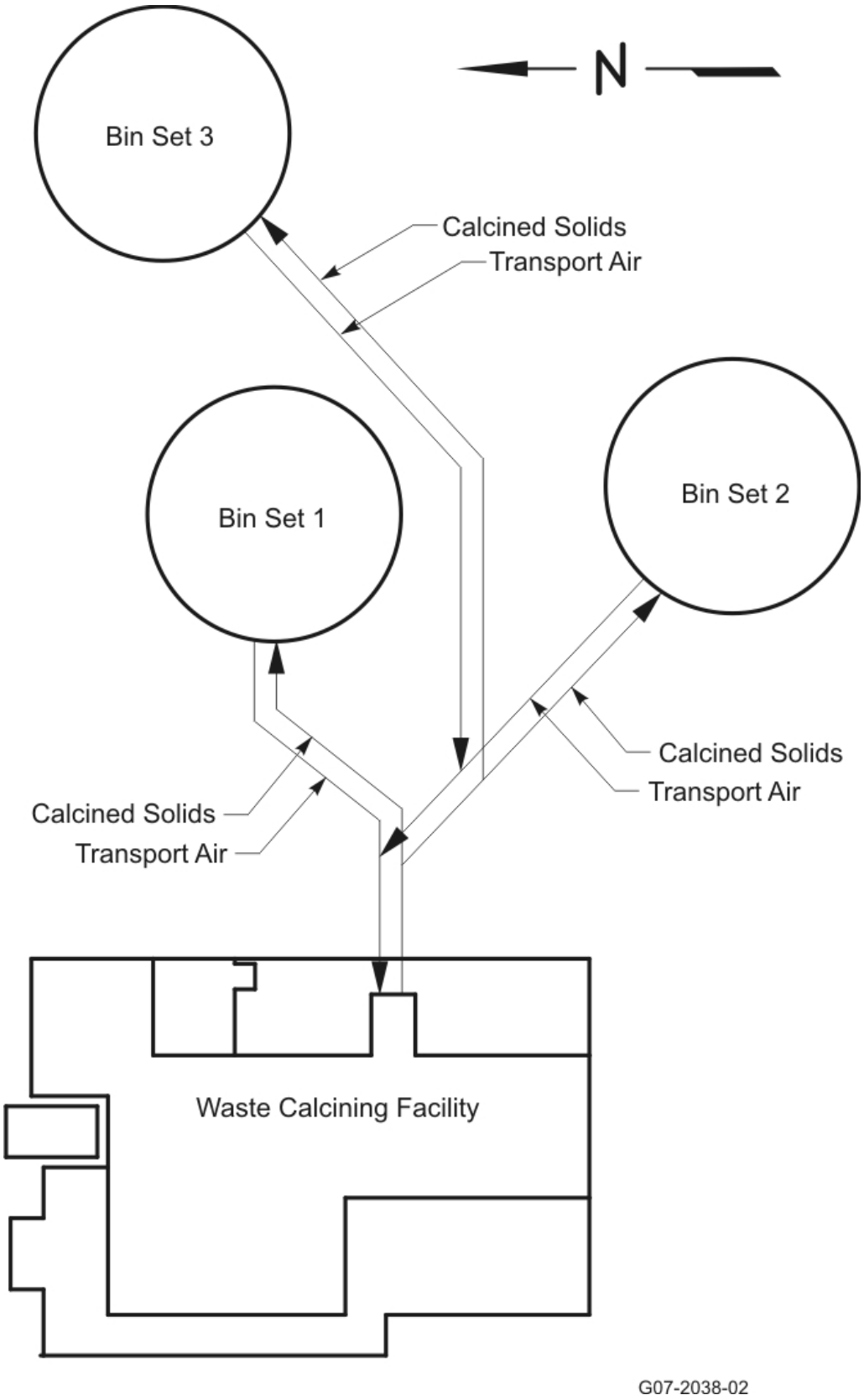


Exhibit D-2. Calcine solids flow.

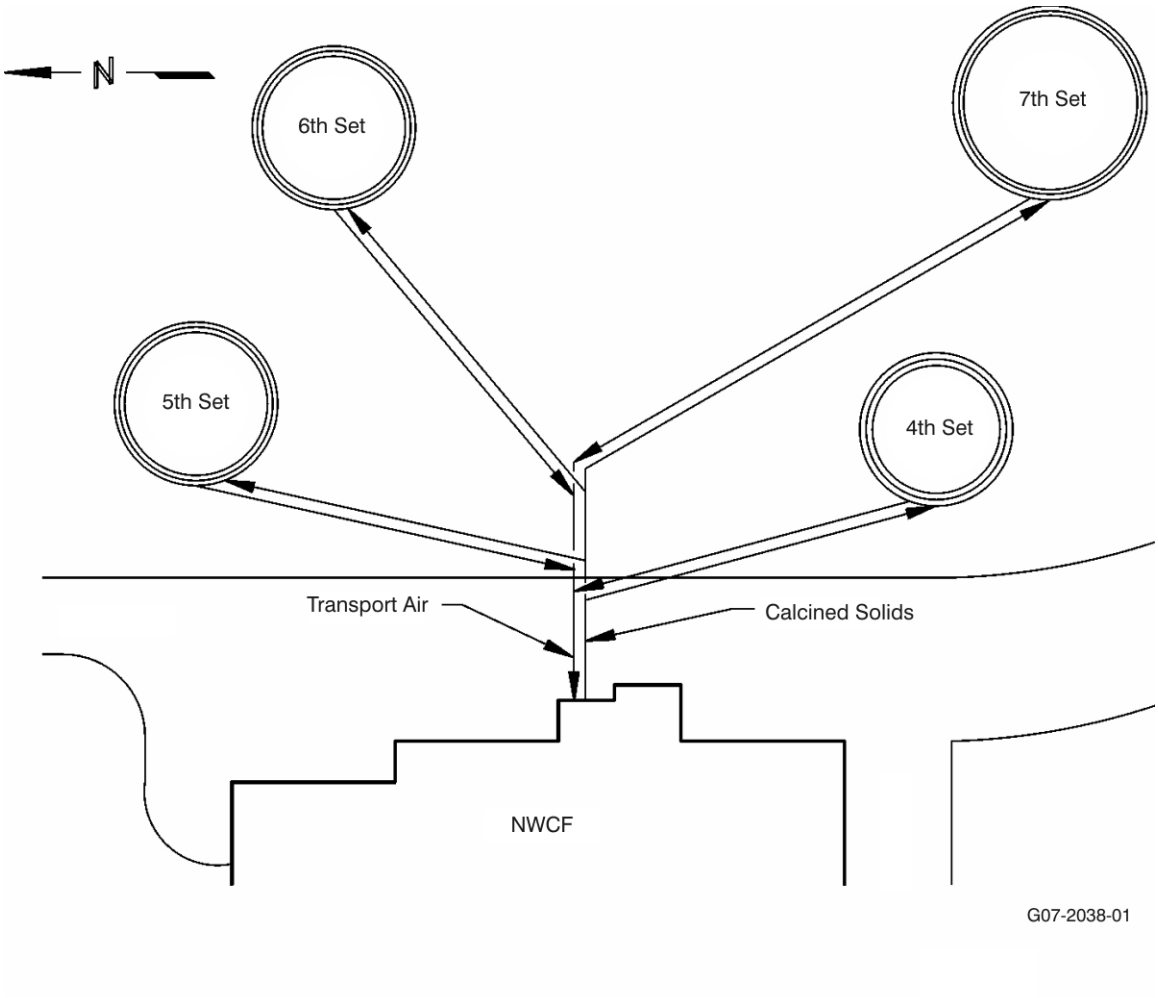


Exhibit D-3. Calcine solids flow.

- Waste piping systems and ancillary equipment associated with Bin Sets 1, 2, and 3 to the point where the transport lines were cut and capped during closure of the WCF. The boundaries for CSSF 1 begin after the cut and cap on Lines 3-TAA-3001 and 3-TAA-3009. The boundaries for CSSFs 2 and 3 begin after the cut and cap on Lines 3-TAA-3032 and 3-TAA-3034 (see Drawings 106576, 118862, and 154129 in Appendix 1).

- Waste piping systems and ancillary equipment associated with Bin Sets 4, 5, 6, and 7. The boundaries for CSSFs 4, 5, 6, and 7 begin with CSSF Valves TAV-WS4-1 and TAV-WS4-2; TAV-WS5-5 and TAV-WS5-4; TAV-WS6-2 and TAV-WS6-5; and TAV-WS7-5 and TAV-WS7-4 shown in Drawings 157798, 158491, 161425 and 009162, respectively, in Appendix 1. Beyond these valves, the "RCRA-Controlled" piping systems and ancillary equipment (including cyclones) are shown in these same drawings, respectively. The bin sets are isolated from the NWCF calciner system by physical devices securing the valves in the closed position on the lines.

D-2a. Existing Tank Systems

The design concept is similar for all the bin sets: vertical, stainless steel bins inside a concrete vault. The vault for CSSF 1 is rectangular and wholly underground. The vaults for CSSFs 2 and 3 are cylindrical, located partially underground and have had gravel berms placed around them. The vaults of CSSFs 4, 5, 6, and 7 are cylindrical, and located partially underground. In addition to housing the bin sets and ancillary equipment, each vault also contains a cyclone cell (for calcine distribution) and instrument room with CSSF monitoring equipment. Exhibit D-4 provides a cutaway view of a typical CSSF vault.

Heat was generated in the CSSF by fission-product decay and was transferred from the bins to the surrounding air. Heat was then conducted from the vault air through the concrete walls surrounding the bins and dissipated to the surrounding soil and air. The temperature within the bins is monitored via thermocouples in various locations and has stabilized to show only ambient temperature fluctuations. Therefore, the ventilation system for cooling was determined to be unnecessary and was secured closed.

The CSSF is equipped with continuous air monitors (CAMs) to detect loss of bin containment. Any loss of containment would result in radioactive materials being suspended in the vault air that would be detected by the CAMs. The pump within the CAM unit allows monitoring of the vault through recirculation of vault air.

If a CAM alarms, a radiological control technician and an operator will have the CAM filter analyzed to determine whether or not a release has occurred. All vaults have been isolated from the atmosphere by mechanically securing the cooling air inlets and outlets closed. As a result there is no motive force to spread contamination outside the vault.

D-2a(1) Assessment of Existing Tank System's Integrity [IDAPA 58.01.05.008 and 58.01.05.012; 40 CFR 264.191 and 270.16(a)]

An assessment prepared by Jason Associates Corporation, *Tank System Integrity Assessment for the Calcined Solids Storage Facility Bin Sets at the Idaho Nuclear Technology and Engineering Center* (see Appendix 2 of this permit reapplication), has determined and provides an independent Professional Engineer certification that the calcine storage bins are adequately designed and have sufficient structural strength and compatibility with the wastes being stored to protect human health and the environment. The facility assessment subsequently determined that the bins in CSSF 1–7 can be permitted for tank storage (7 units) under IDAPA 58.01.05.008, and 40 CFR Part 264, Subpart J requirements.

D-2a(2) Existing Corrosion Protection [IDAPA 58.01.05.008; 40 CFR 264.191(b)(3)]

The tanks and ancillary equipment are contained within concrete vaults. The tank systems do not have RCRA compliant secondary containment, however, a variance from secondary containment is being requested (see Section D-2f). Since the tank systems are located in vaults and the permitted piping is not directly buried in the soil, cathodic protection is not required.

The assessment prepared by Jason Associates Corporation, Tank System Integrity Assessment for the Calcined Solids Storage Facility Bin Sets at the Idaho Nuclear Technology and Engineering Center (see Appendix 2 of this permit reapplication), provides an independent Professional Engineer certification that the CSSF by design, construction, and the nature of the wastes stored are adequate to protect human health and the environment.

D-2b. New Tank Systems [IDAPA 58.01.05.008 and 58.01.05.012, 40 CFR 264.192 and 270.16(f)]

There are no new tank systems associated with the CSSF as installation commenced prior to the July 14, 1986 regulatory date for new tank systems.

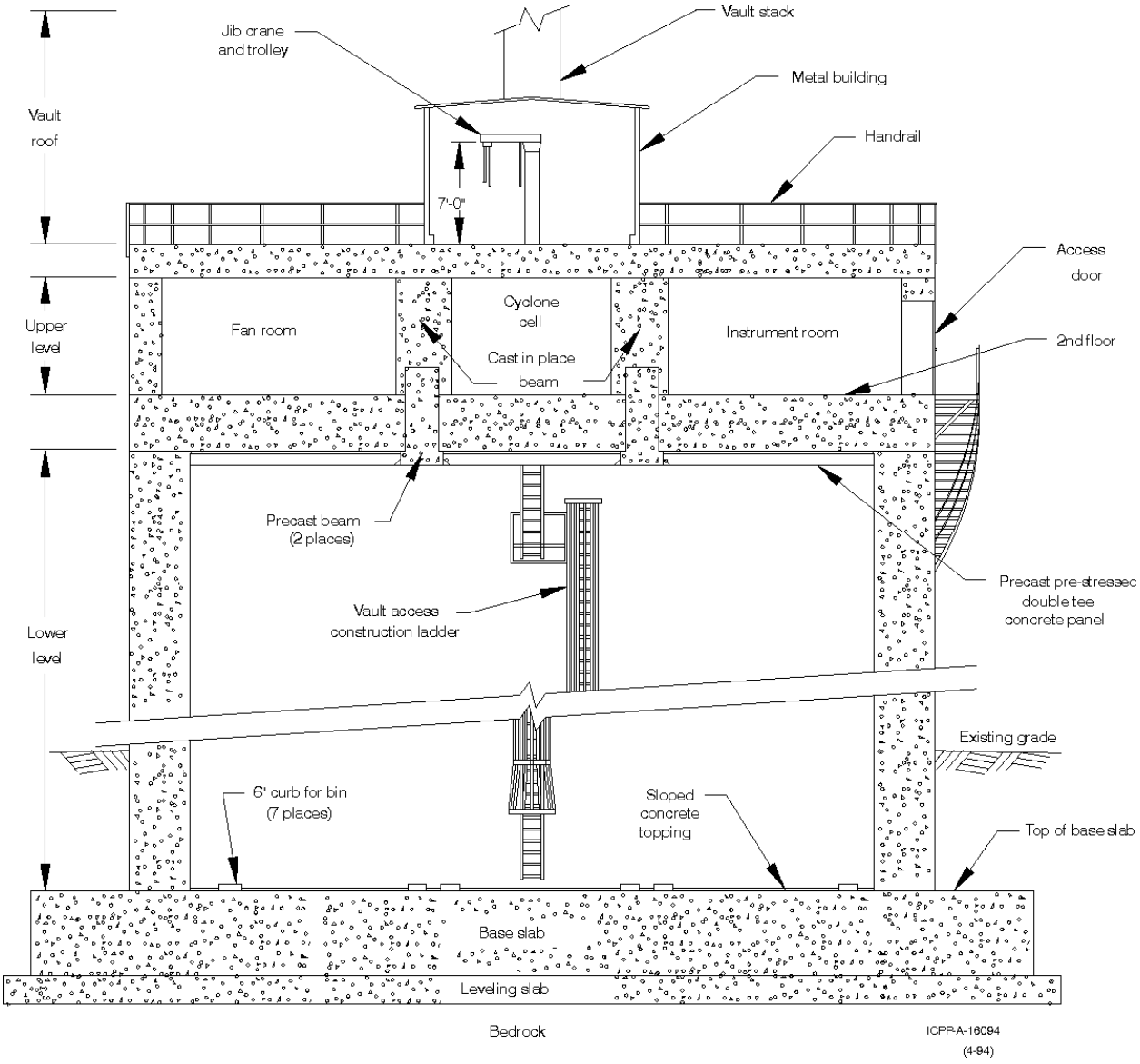


Exhibit D-4. Cutaway view of a typical CSSF vault.

D-2c. Dimensions and Capacity of Each Tank [IDAPA 58.01.05.012; 40 CFR 270.16(b)]

CSSF 1 contains four composite bin sets. Each bin set consists of two concentric ring (annular) tanks with a third, right-circular cylindrical tank located in the middle. There are gaps, of 2 to 3 in. in width, between the two annular tanks and between the inner annular tank and the cylindrical tank to support movement of cooling air between the tanks. The annular tanks are 20 ft tall and the outer one has an inside diameter of approximately 94 in. and an outside diameter of 142 in. The inner annular tanks have an inside diameter of approximately 41 in. and an outside diameter of approximately 90 in. VES-WCC-115-1 through VES-WCC-115-3 cylindrical tanks in the center are 25 ft tall and have a 36-in. diameter. The VES-WC-115-4 cylindrical tank in the center is approximately 27 ft tall and has a 36-in. diameter. Exhibit D-5 provides a cutaway view of the CSSF 1. The date construction and installation commenced, materials of construction, and the date CSSF 1 was filled are provided in Table l. The total, useable and filled volumes are provided in Table 2. CSSF 1 no longer receives calcine and is physically isolated from the closed WCF.

CSSF 2 contains seven bins, or tanks, each a right circular cylinder approximately 42 ft tall and 12 ft in diameter. The vertical tanks are arranged with six of them in a circular pattern that is centered on the seventh. Exhibit D-5 provides a cutaway view of the CSSF 2. The date construction and installation commenced, materials of construction, and the date CSSF 2 was filled are provided in Table l. The total useable and filled volumes are provided in Table 2. CSSF 2 no longer receives calcine and is physically isolated from the closed WCF.

CSSF 3 contains seven bins, or tanks, with a design and layout very similar to that of CSSF 2, except that the six bins arranged in the circular pattern are approximately 53 ft tall and the inner, central bin is 61 ft tall. The diameter of each bin is approximately 12 ft. Exhibit D-5 provides a cutaway view of the CSSF 3. The date construction and installation commenced, materials of construction, and the date CSSF 3 was filled are provided in Table l. The total useable and filled volumes are provided in Table 2. CSSF 3 no longer receives calcine and is physically isolated from the closed WCF.

CSSF 4 contains three bins, or tanks, each a right circular cylinder approximately 55 ft tall with a 12-ft diameter. Exhibit D-6 provides a cutaway view of the CSSF 4. The date construction and installation commenced, materials of construction, and the date CSSF 4 was filled are provided in Table l. The total, useable and filled volumes are provided in Table 2. CSSF 4 no longer receives calcine from the NWCF calciner.

CSSF 5 contains seven bins, or tanks, each a right circular cylinder approximately 50 ft tall, with an outer diameter of 12 ft. These tanks are annular in design with the open annulus measuring 4 ft in diameter (specifically, this is the inner diameter of the annular tank). The seven tanks are arranged in the same pattern as the tanks in CSSFs 2, and 3 (six of them in a circular pattern centered on the seventh). Exhibit D-6 provides a cutaway view of the CSSF 5. The date construction and installation commenced, materials of construction, and the date CSSF 5 was filled are provided in Table l. The total useable and filled volumes are provided in Table 2. CSSF 5 no longer receives calcine from the NWCF calciner.

CSSF 6 contains seven bins, or tanks, with a design and layout very similar to that of CSSF 5, except that each of the seven annular tanks is approximately 68 ft tall, with 13.5-ft outer and 5-ft inner diameters. Exhibit D-6 provides a cutaway view of the CSSF 6. The date construction and installation commenced and the materials of construction are provided in Table 1. CSSF 6 is not filled to capacity. The total useable and current filled volumes are provided in Table 2. CSSF 6 was active when the NWCF calciner was shut down and has remaining capacity.

CSSF 7 contains seven bins, or tanks, which are laid out in the same pattern as the bins in CSSF 6. Each of the seven annular tanks is approximately 68 ft tall, with 13.5-ft outer and 1-ft inner diameters. Exhibit D-6 provides a cutaway view of the CSSF 7. The date construction and installation commenced and the materials of construction are provided in Table l. CSSF 7 is empty and has never stored calcine or other hazardous waste.

Table 1. CSSF–Date construction and installation commenced, materials of construction, and year filled.

CSSF	Date Construction and Installation Commenced	Materials of Construction	Year Filled
1	1959	405 stainless-steel plate	1964
2	1965	304 stainless-steel plate	1972
3	1969	304 stainless-steel plate	1981
4	1976	304L stainless-steel plate	1983
5	1978	304L stainless-steel plate	1992
6	1980	304L stainless-steel plate	Not Full
7	1985	304L stainless-steel plate	Not Used

Table 2. CSSF–Total, useable and filled CSSF volumes.

CSSF	Total (ft^3)	Usable (ft^3)	Filled (ft^3)	% Full
1	8,300	8,000	7,800	96
2	31,600	30,000	30,000	100
3	40,000	39,900	39,500	99
4	17,700	17,200	17,100	100
5	36,200	35,600	35,600	100
6	55,200	53,200	25,600	48
7	63,000	63,000	0	0

Exhibit D-5 and D-6 provide cutaway views of the CSSF 1 - 7.

D-2d. Description of Feed Systems, Safety Cutoffs, Bypass Systems, and Pressure Controls [IDAPA 58.01.05.012; 40 CFR 270.16(c)]

The calcine stored in the CSSF is a solid granular waste form that does not contain free liquids. The bins temperatures are monitored during filling to determine the approximate level of the calcine in each bin.

Safety Cutoffs. There are no safety cutoffs associated with the CSSF.

Bypass Systems. There are no bypass systems associated with the CSSF.

Pressure Controls. Bin vent lines are provided with three pressure relief valves used during bin filling; a high-pressure relief valve, a low-pressure relief valve, and a vacuum relief valve. The high and low pressure relief valves discharge into the vent system exhaust duct, while the vacuum valves allow air to be drawn into the bins.

D-2e. Diagrams of Piping, Instrumentation, and Process Flow [IDAPA 58.01.05.012; 40 CFR 270.16(d)]

A list of drawing numbers and the drawings are located in Appendix 1 of this permit reapplication.

D-2f. Containment and Detection of Releases [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)]

Regulations allow application for a variance from the secondary containment requirements provided the containment is designed and operated to be at least as effective at protecting human health

and the environment as secondary containment. Other considerations include the nature and quantity of the waste and the hydro-geologic setting of the unit.

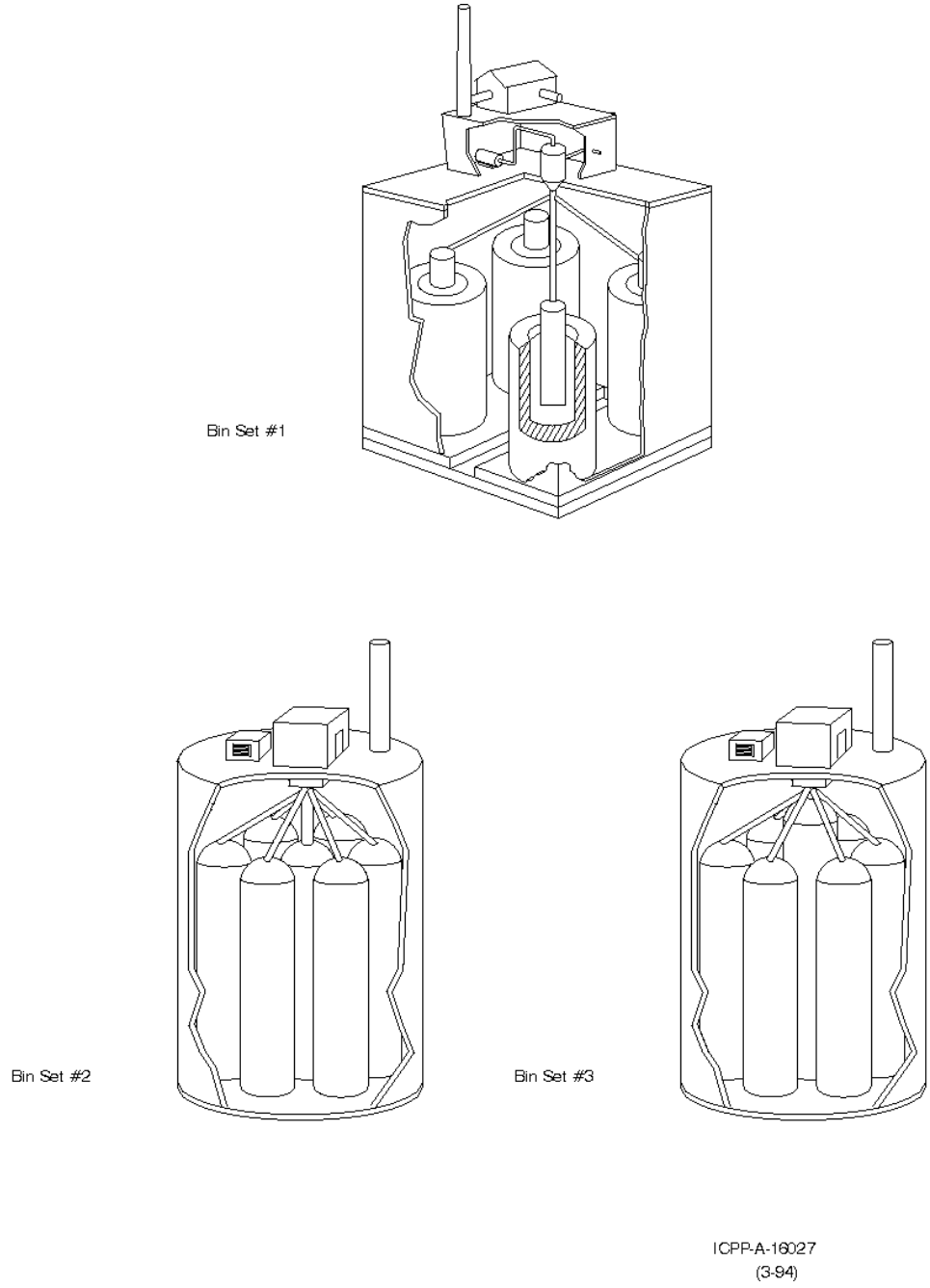
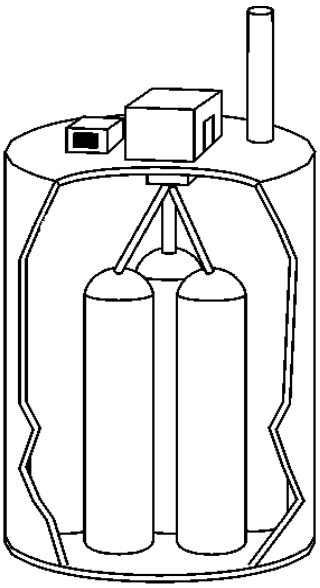
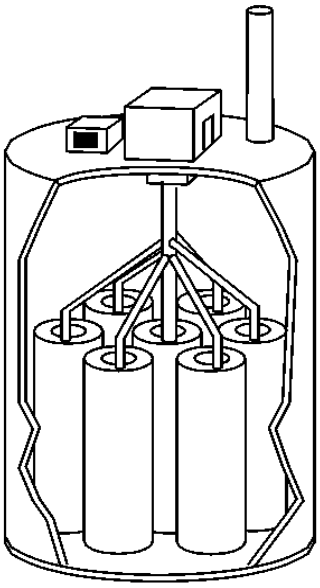


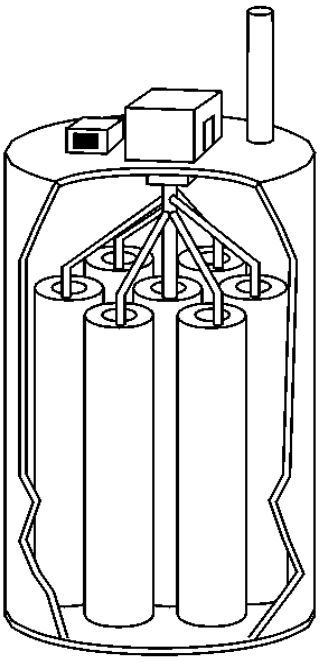
Exhibit D-5. CSSFs 1, 2, and 3 cutaway view.



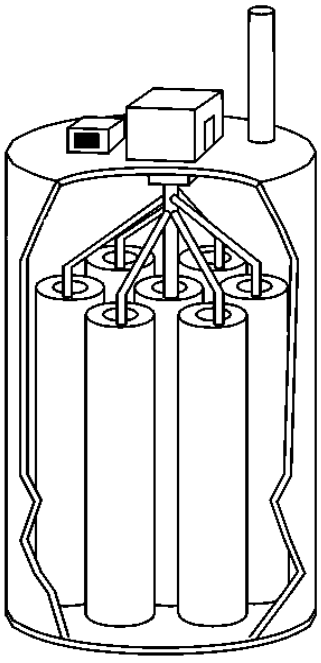
Bin Set #4



Bin Set #5



Bin Set #6



Bin Set #7

ICPP-A-16115
(3-94)

Exhibit D-6. CSSFs 4, 5, 6, and 7 cutaway view.

D-2f(3) Variance from Secondary Containment Requirements [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)]

D-2f(3)(a) Variance Based on a Demonstration of Equivalent Protection of Groundwater and Surface Water [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)(i)]

D-2f(3)(a)(i) Nature and Quantity of the Waste [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)(i)]

The waste stored in the CSSF is a dry, rounded, granular solid. The bin sets containing the calcine are mechanically isolated to prevent addition of materials to the tanks. The chemical nature of the calcine is described in detail in Section C of this permit reapplication. The quantity of wastes stored in the CSSF is listed in Table 2 of Section D.

D-2f(3)(a)(ii) Proposed Alternate Design and Operation of the Containment System [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)(ii)]

In accordance with 40 CFR 264.193(g), a variance may be obtained from the secondary containment requirements if it can be demonstrated that the alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous waste or hazardous constituents into the ground water or surface water at least as effectively as secondary containment during the active life of the tank system. An assessment was prepared in accordance with 40 CFR 264.191 by Jason Associates Corporation, *Tank System Integrity Assessment for the Calcined Solids Storage Facility Bin Sets at the Idaho Nuclear Technology and Engineering Center*, (see Appendix 2 of this permit reapplication), that demonstrates the calcine storage bins and vaults are adequately designed and have sufficient structural strength and compatibility with the wastes being stored to protect human health and the environment at least as effectively as secondary containment.

D-2f(3)(a)(iii) Hydrogeologic Setting of the Facility [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)(iii)]

The hydrology conditions at the INL are addressed in the *DOE Programmatic Spent Nuclear Fuel Management and INEEL Environmental Restoration and Waste Management Programs Final*

Environmental Impact Statement (DOE/EIS - 0203F, Volume 1, Appendix B). A copy of this document has already been provided to DEQ.

D-2f(3)(a)(iv) Other Factors Influencing Quantity and Mobility of the Waste [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(h) and 264.193(g)(1)(iv)]

The following is a list of factors that would influence the quality and mobility of the hazardous constituents and the potential for them to migrate to ground water or surface water.

- In the calciner processes liquid wastes were injected into a high-temperature (400 to 600° C) air-fluidized bed of granular solids. The liquid portion of the waste evaporated and the solids adhered to the granular material-producing calcine. This calcine is dry stable rounded waste form.

- No free liquids have ever been introduced into the bins. The calcine contains no free liquids as a result of the calcining process. No visible evidence of liquids has been observed within the vaults via camera inspections that have been completed to date. Therefore, an external mechanism would be necessary for transport of the calcine outside of the vaults.

- The vaults are monitored for leaks from the bins using CAMs and for liquid infiltration using sumps that are equipped with level indicators and jets for liquid removal. The engineered barrier is the vault boundary. In order for calcine to migrate outside of this boundary a bin would have to leak into the vault. A liquid (which would collect in the vault sump, be detected, and removed) capable of dissolving the calcine would have to be introduced, dissolve the calcine, and then find a path out of the vault to the environment.

- The vault cooling air inlets and outlets are blind-flanged, supporting the condition that air within the vaults does not provide a transport mechanism for calcine out of the vault.

- The INTEC is located in the south-central portion of the INL in Butte County. The physical conditions around these buildings are typical for the INL Site, approximately 5,000 ft above mean sea level. The area is relatively flat and receives little rainfall. The mean annual precipitation at the INL is approximately 8.5 in./yr.

- There is little or no potential for damage to wildlife, crops, vegetation, and physical structures caused by a leak from the CSSF due to the robust construction of the bins and vaults.

D-2g. Controls and Practices to Prevent Spills and Overflows [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.16(i) and 264.194(b)]

The level of calcine in the bins is monitored through temperature variances using thermocouples on the bins. Drawings 106574, 118888, 154127, 157814, 158523, 161448, and 168211 in Appendix 1 of this permit reapplication show the location of the thermocouples in CSSFs 1 through 7, respectively. As calcine is transported to the CSSF, the temperature increases in the bins to correlate with the level of calcine being added. CSSFs 1, 2, 3, 4, 5, and 6 have reached equilibrium temperatures. Thermocouples for these bins are monitored on an annual basis. CSSF 7 is not storing calcine and is not being monitored.

Due to the highly radioactive nature of the calcine, replacement of thermocouples in CSSFs 1 through 6 is not protective of human health. Therefore, as the thermocouples fail, RCRA remedials will not be opened. The annual monitoring of thermocouples will be performed using only those thermocouples that remain functional.

Attachment 2
Section C Waste Characteristics

RCRA PART B PERMIT

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 2 - Section C
Waste Characteristics

Revision Date: December 17, 2025

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C. WASTE CHARACTERISTICS

This section has been prepared for the Idaho Nuclear Technology and Engineering Center (INTEC) Calcined Solids Storage Facility (CSSF) located at the Idaho National Laboratory (INL). The CSSF bins are permitted for tank storage (Process Code S02). The purpose of this section is to describe the process and rationale utilized by the contractor to determine the physical and chemical characteristics of the wastes managed at these units. This section describes hazardous wastes and only the hazardous components of mixed wastes regulated by Hazardous Waste Management Act (HWMA)/ Resource Conservation and Recovery Act (RCRA), the Idaho Administrative Procedures Act (IDAPA), and the Code of Federal Regulations (CFR).

The CSSF is composed of seven bin sets designed to store high-activity mixed wastes produced from calcination in the Waste Calcining Facility (WCF), from 1963 through 1981, and the New Waste Calcining Facility (NWCF), from 1982 through 2000. The bin sets are comprised of an arrangement of bins contained within a concrete vault. Detailed descriptions of CSSF composition and bin set arrangement are provided in Sections B and D of this Part B permit reapplication.

C-1 CHEMICAL AND PHYSICAL ANALYSES: [IDAPA 58.01.05.012 and .008; 40 CFR §§ 270.14(b)(2) and 264.13(a)]

The CSSF units described in this permit reapplication store calcine generated by the WCF and NWCF. Calcine is a granular solid mixed waste without free liquids regulated as hazardous under IDAPA 58.01.05.005 (40 CFR 261, Subparts C and D) and radioactive under the Atomic Energy Act.

Radionuclides that contribute the majority of the activity for wastes managed in the CSSF include Sr-90, Y-90, Ba-137m, and Cs-137. Activity of typical calcine is approximately 10 mCi/g. The exposure rates associated with the calcine routinely exceed 10 rem/h on a 15-mL sample and can pose a potentially serious hazard to workers at the INL, if appropriate protective measures such as time, distance, and shielding are not applied.

Due to the highly radioactive nature of wastes managed in the CSSF, characterization and the assignment of Environmental Protection Agency (EPA) hazardous waste numbers (HWNs) occur through the use of acceptable knowledge, which involves both process knowledge and/or chemical/physical testing of the waste.

Characteristic HWNs may be applied by testing the waste according to the methods set forth in Subpart C of 40 CFR Part 261, or according to an equivalent method approved by the Director of the Idaho Department of Environmental Quality (DEQ), or by applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.

The RCRA Part A Permit application for the CSSF shows 8 EPA HWNs. All eight (8) are characteristic HWNs.

Core samples of alumina and zirconia calcine were obtained from bins within Bin Set 2 in 1978. The purpose of the 1978 sampling was to obtain information on the physical properties and condition of the stored calcine and to determine whether changes occurred during calcine storage to support long-term waste management and calcine retrieval studies. The alumina calcine was retrieved from Bin No. 3 in Bin Set 2, and the zirconia calcine was retrieved from Bin No. 7 in Bin Set 2. These samples were analyzed for radiological constituents. The analytical results showed that the calcine remained unchanged from the time of placement.

Sub samples were taken from the 1978 core samples in June 2003 for RCRA characterization analysis. The overall purpose of this sampling effort was to: (1) provide analyses of a representative sample of the waste in support of the original permit application; (2) correlate characterization data from sampling and analysis of the calcine with predicted modeled values (flow sheets) that were based on characterization of the liquid waste feed to the calciner; and (3) determine whether organic constituents are present in the calcine at concentrations requiring application of the HWMA/RCRA toxicity characteristic codes.

Samples of alumina and zirconia calcine were also collected from the NWCF during a processing campaign in 1993. This calcine was analyzed at the same time as the sub samples collected during the June 2003 sampling event. The analytical data for the samples is shown in Appendix 3 of this permit.

C-1b Waste in Tank Systems: [IDAPA 58.01.05.008; 40 CFR §§ 264.191(b)(2) and 264.192(a)(2)]

The characteristics of calcine produced from the treatment of liquid radioactive waste correspond to the characteristics of the liquid wastes fed to the calciners. When the calcining process was initiated, the waste feed primarily resulted from the processing and recovery of enriched uranium from spent nuclear fuel. The spent fuels contained aluminum, stainless steel, graphite, or Zircaloy^{R} (a zirconium alloy) as the primary fabrication or cladding material. The chemical characteristics of calcine produced as a result of spent fuel reprocessing were determined and documented based upon the unique constituents contained in each type of fuel element and the methodology used for reprocessing. Later, when spent nuclear fuel reprocessing was discontinued at the INTEC in the early 1990s, other liquid radioactive wastes were calcined. These included liquid mixed wastes generated from activities such as decontamination and subsequent (after first cycle) processing of spent nuclear fuel. These solutions were generally high in sodium and potassium nitrates and are referred to as sodium-bearing waste (SBW). Other newly generated liquid mixed wastes (NGLW), primarily associated with decontamination activities not associated with processing spent fuel, were also transferred to the INTEC Tank Farm Facility. These wastes were subsequently calcined, and are currently stored in the CSSF.

Bin Sets 1, 2, and 3 received calcined waste from the WCF only. These wastes were generated from spent nuclear fuel reprocessing operations occurring at the INTEC. Bin Sets 4, 5, and 6 received calcined waste from the NWCF only. These bins contain calcine resulting from spent fuel reprocessing, SBW, and NGLW. Bin Set 7 has not received any waste.

The chemical composition of calcine includes metal oxides and metal salts of aluminum, boron, cadmium, calcium, chromium, mercury, radionuclides, sodium, and zirconium. The concentration of the principal constituents of aluminum, cadmium, calcium, chromium, fluoride, mercury, sodium, and zirconium is variable, depending on the composition of the waste calcined. Typical calcine composition for each type of liquid radioactive waste treated is given in Table C-1. Approximate calcine composition by Bin Set for Bin Sets #1 through #6 is given in Table C-1.a.

Aluminum, zirconium, zirconia-sodium, and aluminum-sodium calcine are readily distinguished from each other on the basis of chemical composition. Aluminum calcine is predominantly aluminum oxide and contains small amounts of mercury compounds. Zirconium blends can be distinguished from other calcine types by the high percentages of zirconium oxide and calcium fluoride and the absence of cadmium oxide. Zirconia-sodium calcine is readily distinguished from other types by the sodium and potassium content. Aluminum-sodium calcine is readily distinguished from other types by the aluminum oxide and sodium content.

Table C-1. Typical calcined product composition [a] - excluding oxide (in wt%).

Component	Waste Type			
	Aluminum	Zirconium	Fluorinel/SBW	Aluminum Nitrate/SBW
Aluminum	87.3	20.0	20.0	53.4
Boron	0.4	1.1	1.0	0.8
Cadmium	N/A	N/A	5.5	0.2
Calcium	N/A	32.0	31.9	4.0
Chloride	N/A	N/A	0.1	0.4
Chromium	N/A	0.4	0.1	0.1
Fluoride	N/A	25.0	21.9	1.0
Iron	0.1	0.3	0.2	0.4
Mercury	5.5	N/A	0.001	0.003
Nitrate	2.6	0.1	8.1	23.0
Potassium	0.1	0.1	0.9	2.5
Sodium	1.4	N/A	4.1	11.4
Sulfate	1.5	N/A	3.7	1.4
Tin	N/A	0.3	0.2	N/A
Zirconium	N/A	18.2	15.5	0.3

[a] Source: Staiger (2003), Table 3.
SBW = sodium-bearing waste

Table C-1.a. Approximate calcine composition by Bin Set (for Bin Sets #1 to #6).

Component	**Weight %**					
	Bin Set #1	**Bin Set #2**	**Bin Set #3**	**Bin Set #4**	**Bin Set #5**	**Bin Set #6** [d]
Al_2O_3	90.6	39.5	23.8	14.2	14.2	58.8
ZrO_2	---	14.8	17.3	19.4	19.9	2.4
CaF_2	---	34.1	40.3	45.2	46.4	6.8
B_2O_3	0.6	2.1	2.3	2.6	2.6	1.5
Na_2O	3.1	1.0	1.9	4.2	3.6	7.9
K_2O	---	---	0.1	0.9	0.7	1.8
CaO	---	2.5	5.9	8.0	10.9	7.1
Fe_2O_3	0.6	0.3	0.2	0.3	0.2	1.0
Hg	2.9	1.0	---	---	---	---
SO_4	1.2	0.4	0.1	0.3	0.3	1.0
PO_4	---	---	0.1	0.1	0.2	0.1
Cl	---	0.1	0.1	0.1	0.1	0.2
Other	1	4 [b]	8.0[b]	4.8 [b]	1.0	0.7
NO_3 [c]	1	1	~3.5	~5	~5	10.5

a. Source: Berreth (1988), Tables 4-3 and 4-4. NOTE; The referenced Table 4-3 also shows CdO and SnO_2, which are not depicted in Table 4-4 or in the table above.
b. Bin Sets #2, #3, and #4 includes about 3%, 7%, and 4%, respectively as dolomite [$CaMg(C0_3)_2$] start-up material.
c. NO_3 is present as percent of total calcine composition.
d. The composition for Bin Set #6 includes dolomite as components, not as "Other" as previously specified for Bin Sets #1 through #5.

Generally calcine is composed of dry white-to-gray, black, brown, or rust-colored subrounded to rounded grains that average 0.2 mm to 1.0 mm in diameter. The bulk density of calcine varies between 1.0 and 1.7 g/cm^3

C-2 WASTE ANALYSIS PLAN: [IDAPA 58.01.05.008 and 012; 40 CFR §§ 264.13(b) and 270.14(b)(3)]

The regulations under RCRA, as implemented through IDAPA 58.01.05.008 (40 CFR § 264.13), require a Waste Analysis Plan (WAP) for regulated waste management units. This WAP identifies what waste characterization information is needed, the nature and extent of information required, the method(s) by which the information is gathered, and the quality assurance and quality control (QA/QC) goals.

The process outlined in this WAP is implemented for characterization of all mixed/hazardous wastes or potentially hazardous wastes managed at the INTEC units described herein. Wastes subject to this plan include wastes generated from INL operations and treatment residues generated from INL RCRA-regulated waste management activities. As such, this WAP is intended for inclusion in day-to-day waste management operations.

This WAP is established to ensure that all data used for waste characterization are scientifically valid, defensible, and of known precision and accuracy. This objective relies on the identification of appropriate parameters and rationale, analytical methods, sampling methodologies, and quality control.

The objectives of this WAP are as follows:

- Ensure that sufficient information is available to provide safe handling, storage, and treatment of waste materials
- Define the parameters for characterization and the rationale for selection
- Establish consistent sampling, sample management, analytical methods, parameter selection, and controls for wastes received and generated
- Provide a description of the waste stream characterization and approval process from the point of waste generation through final disposition of the waste

- Establish unit-specific waste acceptance criteria (where necessary) for treatment units to ensure that sufficient information is available to determine whether the wastes considered for storage at the respective units meet the requirements established in this permit reapplication

- Define land disposal restriction (LDR) requirements applicable to wastes managed in the miscellaneous treatment, and storage units

- Verify that EPA HWNs for wastes stored or treated are acceptable per the EPA HWNs listed in the Part A permit application.

This WAP will be revised whenever test methods are changed or whenever regulations change that affect the WAP.

C-2a Parameters and Rationale: [IDAPA 58.01.05.008; 40 CFR §§ 264.13(b)(1) and (2)]

Tables C-2 and C-3 outline the parameters for analysis and corresponding rationale that are employed to perform hazardous waste determinations in accordance with IDAPA 58.01.05.006 (40 CFR § 262.11) and to assess LDR requirements. The parameters and rationale presented in these tables are selected to ensure compliance with RCRA and unit-specific waste acceptance requirements, and guarantee safe, compliant treatment and storage. Not all of the parameters identified in Tables C-2 and C-3 are selected for each waste stream. Only the specific parameters applicable to each waste stream are evaluated.

Wastes are characterized and LDR requirements are determined at the point of generation by facility personnel with assistance from other contractor organizations, as needed, by analyzing the waste or by applying process knowledge. The following are examples of process knowledge:

- Raw materials used – knowledge of the type, quantity, and concentration of raw materials used in the system combined with detailed knowledge of the generating process may provide enough information to adequately characterize the waste.

- Process description – pertinent details of the process generating the waste and the chemicals used in the process must be described. The more complex the process, the more information would be required.

- Chemical/material composition specifications – chemical specifications may be available from the purchase specifications of a particular chemical, from product information provided by the manufacturer, or from the labels for the particular chemical in question. For pure chemicals whose contents and characteristics are known (e.g., nitric acid), standard chemical reference materials may supply the required information. Standard material composition reference tables may supply the required information for metals, plastics, and other materials manufactured to certain grades, alloy specifications, etc., whose material contents and characteristics are well known (e.g., Type 304 stainless steel).

- Safety data sheets (SDSs) – chemical specifications and related information are available on these standard reference materials. SDSs may be provided by the manufacturer or acquired through available SDS databases.

- Process reference materials including laboratory notebooks, strip charts, correspondence, chemical analyses, and analytical reports.

- Analytical reports from non-SW-846 chemical analyses or information from similar processes.

If process knowledge is adequate to ensure that a particular constituent is not present in the waste, then analysis for that constituent will not be performed. If process knowledge is not sufficient to eliminate a particular parameter, then that parameter will undergo selection for testing.

Specific parameters selected for RCRA characterization analysis are determined on a case-by-case basis. Facility personnel select the appropriate parameters based on knowledge of the waste source, unit-specific waste acceptance criteria (WAC), and characterization requirements to identify RCRA-regulated wastes. This ensures that the appropriate parameter selection will be matched with the correct analytical method(s) to generate the data required for subsequent management of the waste within the CSSF.

All process knowledge determinations and RCRA characterization analytical results are documented in the facility operating record.

Table C-2. Test methods for waste analysis parameters and rationale.

PARAMETER	TEST METHOD(S)[a]	RATIONALE
Toxicity characteristic	1311 Toxicity characteristic leaching Procedure (TCLP) or process knowledge	Determine the waste and LDR status.
Metals: antimony arsenic barium beryllium cadmium chromium lead mercury nickel selenium silver thallium	3005A, 3010A, 3050B, 3051, 3052, 6010, 7470, 7471 or process knowledge	Determine if the waste is characteristically hazardous for toxicity. Determine reasonably expected underlying hazardous constituents (UHCs).
Volatile and semi-volatile organic compounds	5030B, 5035, 8015, 8082, 8260B, 3510C, 3550B, 3600C, 8270C or process knowledge	Determine whether the waste is characteristically toxic for organic compounds or whether listed waste constituents can be detected. Identify reasonably expected UHCs.
Flash point	1010, 1020, ASTM D93-80, D3828-81 or process knowledge	Determine if waste is characteristically ignitable.
Corrosivity/Acidity, pH or Corrosivity toward steel	ACMM 7012[b], 9040B, 9045C, 9441A or process knowledge	Determine if the waste is characteristically corrosive.
Reactivity (cyanides, sulfides, water reactive, chemical stability, shock sensitive)	C003[c], 9010B, 9013, 9014, 9030B, 9031, 9034, or process knowledge	Determine if waste is characteristically reactive and prevent mixing of incompatible wastes in tank and treatment systems.
Free liquids	9095A Paint Filter Liquids Test, visual inspection or process knowledge	Determine whether the waste is a solid or a liquid.
Total organic carbon (TOC)	9060 or process knowledge	Determine whether organics may be present in measurable quantities.

ASTM = American Society for Testing and Materials
ACMM = Analytical Chemistry Methods Manual

a. Methods are from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, unless otherwise stated.
b. G. L. Booman, M. C. Elliot, R. B. Kimball, F. O. Cartan, J. E. Rein, "Determination of Free Acid in the Presence of Hydrolyzable Ions," Analytical Chemistry, 30 No. 2 (February 1958), pp. 284-287.
c. Arthur D. Little, Inc., Sampling and Analysis Methods for Hazardous Waste Combustion, EPA-600/8-84-002, NTIS No. PN84-1555845, February 1984.

Table C-3. Test methods, parameters, and rationale for LDR status.

PARAMETER	TEST METHOD(S)[a]	RATIONALE
Toxicity characteristic	1311 Toxicity Characteristic Leaching Procedure (TCLP) or process knowledge	Determine waste and LDR status for toxicity.
Metals: antimony arsenic barium beryllium cadmium chromium lead mercury nickel selenium silver thallium	3005A, 3010A, 3050B, 3051, 3052, 6010, 7470, 7471 or process knowledge	Determine LDR status for toxicity. Evaluate mercury subcategory and UHCs.
Volatile and Semivolatile organic compounds	5030B, 5035, 8015, 8082, 8260B, 3510C, 3550B, 3600C, 8270C or process knowledge	Determine listed waste and LDR status for toxicity. Evaluate UHCs.
Flash point	1010, 1020, ASTM D93-80, D3828-81 or process knowledge	Determine LDR status for ignitability.
Corrosivity/Acidity, pH or Corrosivity toward steel	ACMM 7012[b], 9040B, 9045C, 9441A or process knowledge	Determine LDR status for corrosivity.
Reactivity (cyanides, sulfides, water reactive, chemical stability, shock sensitive)	C003[c], 9010B, 9013, 9014, 9030B, 9031, 9034, or process knowledge	Determine LDR status for reactivity and subcategory.
Free liquids	9095A Paint Filter Liquids Test, visual inspection or process knowledge	Determine whether the waste is a solid or a liquid.
Total organic carbon (TOC)	9060 or process knowledge	Determine wastewater or nonwastewater category
Total suspended solids (TSS)	160.1[d] or process knowledge	Determine wastewater or nonwastewater category

ASTM = American Society for Testing and Materials
ACMM = Analytical Chemistry Methods Manual

a. Methods are from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, unless otherwise stated.
b. G. L. Booman, M. C. Elliot, R. B. Kimball, F. O. Cartan, J. E. Rein, "Determination of Free Acid in the Presence of Hydrolyzable Ions," Analytical Chemistry, 30 No. 2 (February 1958), pp. 284-287.
c. Arthur D. Little, Inc., "Sampling and Analysis Methods for Hazardous Waste Combustion," EPA-600/8-84-002, NTIS No. PN84-1555845, February 1984.
d. "Methods for Chemical Analysis for Water and Wastes," EPA-600/4-79-020.

C-2a(1) Waste Acceptance Criteria

Wastes processed in the WCF and NWCF were required to meet their WAC prior to acceptance and treatment. Upon generation, calcine was transported to the CSSF for storage without further evaluation.

Although, the CSSF bins are not currently receiving any waste, this permit reapplication allows for the continued use of the Bin Sets 1, 2, 3, 4, and 5 for storage and Bin Sets 6 and 7 for storage and to receive future waste transfers.

The WCF has been closed as a RCRA landfill and the NWCF has undergone RCRA-regulated closure. As part of closure, the waste transfer lines from the WCF were cut and capped and the waste transfer lines from the NWCF to the CSSF have been physically isolated in accordance with the approved closure plan.

C-2a(2) Waste Acceptance Process

Wastes stored in the CSSF were calcined in either the WCF or the NWCF. The WCF completed RCRA-regulated closure in November 1999. RCRA-regulated closure for the NWCF calciner was completed in December 2004.

LDR Requirements

Point-of-generation facility personnel provide waste characterization information and use this information to complete LDR notifications, per IDAPA 58.01.05.011 (40 CFR § 268.7). In cases where facility personnel determine that an LDR waste does not meet the applicable treatment standard(s) set forth in IDAPA 58.01.05.011 (40 CFR § 268, Subpart D), or exceeds the applicable prohibition level(s) set forth in IDAPA 58.01.05.011 (40 CFR § 268.32) or Section 3004(d) of RCRA, facility personnel provide written notice in accordance with IDAPA 58.01.05.011 [40 CFR § 268.7(a)(2)].

In cases where facility personnel determine that a restricted waste is being managed that can be land-disposed without further treatment, facility personnel submit written notice stating that the waste meets (or is exempt from) applicable treatment standards set forth in IDAPA 58.01.05.011 (40 CFR § 268, Subpart D) and the applicable prohibition level(s) set forth in IDAPA 58.01.05.011 (40 CFR § 268.32) or Section 3004(d) of RCRA. The notice must be in accordance with IDAPA 58.01.05.011 [40 CFR § 268.7(a)(3)].

Point-of-generation facility personnel provide LDR notices. Required LDR notifications will be prepared as necessary prior to shipment of any treatment residuals for final disposal according to applicable laws and regulations.

C-2b Test Methods: [IDAPA 58.01.05.008; 40 CFR § 264.13(b)(2)]

Waste Analysis

Analytical methods employed are primarily taken from EPA's *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (SW-846, current edition). In those cases where method-defined parameters[1] are required by regulation, SW-846 methods are always employed. Examples of method-defined parameter methods, where the analytical result is wholly dependent on the process used to make the measurement, include the use of the TCLP to prepare a leachate, flash point, pH, corrosivity tests, and paint filter liquids. The cited test methods will be performed at the laboratories per controlled implementing procedures.

The EPA provides for a degree of flexibility in the use of SW-846 and other approved methods. This flexibility is dependent on the maintenance of precision, accuracy (or bias), recovery,

1. The use of an SW-846 method is mandatory for the following Resource Conservation and Recovery Act (RCRA) applications contained in 40 CFR Parts 260 through 270:
   - Section 260.22(d)(1)(i) - Submission of data in support of petitions to exclude a waste produced at a particular facility (i.e., delisting petitions)
   - Section 261.22(a)(1) and (2) - Evaluation of waste against the corrosivity characteristic
   - Section 261.24(a) - Leaching procedure for evaluation of waste against the toxicity characteristic
   - Section 261.35(b)(2)(iii)(A) - Evaluation of rinsates from wood preserving cleaning processes
   - Sections 264.190(a), 264.314(c), 265.190(a), and 265.314(d) - Evaluation of waste to determine if a free liquid is a component of the waste
   - Sections 264.1034(d)(1)(iii) and 265.1034(d)(1)(iii) - Evaluation of organic emissions from process vents
   - Sections 264.1063(d)(2) and 265.1063(d)(2) - Evaluation of organic emissions from equipment leaks
   - Section 266.106(a) - Evaluation of metals from boilers and furnaces
   - Sections 266.112(b)(1) and (2)(i) - Certain analyses in support of exclusion from the definition of a hazardous waste for a residue which was derived from burning hazardous waste in boilers and industrial furnaces
   - Sections 268.7(a), 268.40(a), (b), and (f), 268.41(a), 268.43(a) - Leaching procedure for evaluation of waste to determine compliance with land disposal treatment standards
   - Sections 270.19(c)(1)(iii) and (iv), and 270.62(b)(2)(i)(C) and (D) - Analysis and approximate quantification of the hazardous constituents identified in the waste prior to conducting a trial burn in support of an application for a hazardous waste incineration permit
   - Sections 270.22(a)(2)(ii)(B) and 270.66(c)(2)(i) and (ii) - Analysis conducted in support of a destruction and removal efficiency (DRE) trial burn waiver for boilers and industrial furnaces burning low risk wastes, and analysis and approximate quantification conducted for a trial burn in support of an application for a permit to burn hazardous waste in a boiler and industrial furnace. Federal Register, Thursday, November 20, 1997, Vol. 62, No. 224, 62079.

representativeness, comparability, and sensitivity (detection, quantitation, or reporting limits) relative to the data quality objectives for the intended use of the analytical results. "If an alternative analytical procedure is employed, then EPA expects the laboratory to demonstrate and document that the procedure is capable of providing appropriate performance for its intended application. This demonstration must not be performed after the fact, but as part of the laboratory's initial demonstration of proficiency with the method. The documentation should be in writing, maintained in the laboratory, and available for inspection upon request by authorized representatives of the appropriate regulatory authorities" (SW-846, Chapter Two, "Choosing the Correct Procedure").

Joint EPA/Nuclear Regulatory Commission (NRC) guidance[2] for mixed waste also provides flexibility in sample sizes with method-defined parameter methods, as long as the resulting test is sufficiently sensitive to measure the constituents of interest at the regulatory levels prescribed in the TCLP. Other variances to published testing and sampling protocols are permissible under 40 CFR §§ 260.20-21, but must be approved prior to implementation by the Director of the DEQ.

The EPA allows for the use of recognized methods other than those prescribed in SW-846. "Whenever methods from SW-846 are not appropriate, recognized methods from source documents published by the EPA, American Public Health Association (APHA), American Society for Testing and Materials (ASTM), the National Institute for Occupational Safety and Health (NIOSH), or other recognized organizations with appropriate expertise should be used, if possible" (SW-846, Chapter One).

Because of the broad range of acceptable methods available for testing specific constituents, and with the rapid incorporation/deletion of methods, not all of the SW-846 methods are specified in Tables C-1 and C-2. Only the currently defined parameter methods are specified.

Calcine requires remote handling and is subject to full RCRA characterization requirements. The remote sample handling requirements and specific process stream requirements may cause deviations in some required analyses systems. For example, the EPA has determined that "if the analyst can demonstrate that the test is still sufficiently sensitive (in the case of reduced sample size in a TCLP extraction) to measure the constituents of interest at the regulatory levels specified in the TCLP and representative of the waste stream being tested" then the sample size can be legitimately decreased.[3] Sample size becomes a critical factor, especially with respect to radiation exposure hazards, and therefore, must be a factor for consideration in any sampling or analytical activity.

2. *Federal Register*, Thursday, November 20, 1997, Vol. 62, No. 224, 62079.

3. Federal Register, Thursday, November 20, 1997, Vol. 62, No. 224, 62079.

The analyses may be performed at INL laboratories or at approved off-Site laboratories. Laboratories contracted by the contractor to perform outside work are audited periodically, to ensure that each laboratory's quality control procedures and standard practice manuals meet the requirements for laboratories conducting EPA test procedures. If the laboratory has not been audited, or has failed to conform to the audit criteria, that laboratory is not authorized by the contractor to conduct waste characterization analysis.

Process Knowledge

The EPA/NRC guidance emphasizes the use of process knowledge to determine if a radioactive waste is hazardous, as a way to avoid unnecessary exposures to radioactivity. Examples of the types of process knowledge information used to characterize wastes for the CSSF are presented in Section C-2a of this permit reapplication. The INL documents process knowledge through Waste Determination and Disposition Forms (WDDFs - waste stream profiles), correspondence, and memoranda maintained in the Document Management System. As a best management practice, the characterization documentation for all active waste streams is reviewed and each stream is recertified annually to ensure the information maintained remains accurate and complete.

All waste characterization information, including documentation of process knowledge, is maintained in the facility operating record.

C-2c Sampling Methods: [IDAPA 58.01.05.008 and 005; 40 CFR § 264.13(b)(3), Part 261 Appendix I]

Facility personnel, in conjunction with Waste Generator Services (WGS), and other organizations as needed, are responsible for characterizing wastes received into the CSSF. Personnel can use process knowledge and/or testing to adequately characterize waste. As part of characterization, the appropriate sampling method is selected based on knowledge of the waste material matrix (e.g., solid, liquid, sludge, radiological component) and radiation exposure considerations, as well as the specific analyte of interest. Facility personnel are also responsible for arranging all sampling and laboratory support and for sample shipments. Sampling personnel document the sampling activities and chain of custody.

Representative waste samples are obtained in accordance with the sampling approaches described in Chapter Nine of Test *Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (SW-846, current edition). Samples are collected using appropriate equipment and methods identified in, but not limited to, the following sources:

- EPA Test Methods for Evaluating Solid Waste, SW-846, Chapter 10, "Sampling Methods," Third Edition
- 40 CFR 261, Appendix I, "Representative Sampling Methods"
- Annual Book of ASTM Standards, American Society for Testing and Materials, Current issue
- Characterization of Hazardous Waste Sites - A Methods Manual, Volume II, Available Sampling Methods, EPA-600/4-84-076, 2nd Edition, December 1984
- "Characterizing Heterogeneous Wastes: Methods and Recommendations," EPA/600/R-92/033, February 1992
- EPA Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Wastes: A Guidance Manual, April 1994
- Other recognized methods from source documents published by the EPA, APHA, ASTM, the NIOSH, or other recognized organizations with appropriate expertise.

The Director of the DEQ must approve any sampling methods that deviate from approved or other recognized methods prior to implementation.

C-2c(1) Standard Sampling Methods

Due to the highly radioactive nature of the calcine stored in the CSSF, sampling occurs infrequently.

Any sampling will be completed in accordance with an approved sampling and analysis plan and conducted in accordance with approved sampling and operating procedures. In general, where standard samples are collected, the following basic sampling guidance is used:

- Obtain samples using precleaned sample equipment, in accordance with the applicable method.
- Fill sample containers. Uniquely identify and label each sample, and document necessary information in the field record (e.g., location, time, characteristics).
- Properly clean and decontaminate the exterior of the sample containers and the sampling hardware.

- Complete the chain-of-custody forms and retain a record copy.

- Deliver the samples and associated forms to the laboratory.

Sampling procedures for calcine may deviate from the standard sampling protocols, due to the hazards associated with radioactive materials. For example, due to radiological concerns, the use of remotely operated sample transfer systems may limit the size of sample containers, prevent sealing of the transfer receptacle, or preclude chain-of-custody and other documentation from directly accompanying the samples. However, all sampling procedures are consistent with the stated goals of SW-846, to collect representative samples and maintain their physical and chemical integrity.

Equipment used to sample waste is disposable or designed for decontamination. Contaminated disposable equipment is managed appropriately. Equipment that can be cleaned and reused is thoroughly decontaminated before reuse or storage. Decontamination solutions are managed appropriately.

C-2c(1)(a) Field Records

Records provide direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning project activities. These records, particularly those anticipated to be used as evidentiary data, directly support current or ongoing technical studies and activities, and provide the historical evidence needed for later reviews and analyses.

Field records may consist of bound field notebooks, sample collection forms, personnel qualification and training forms, sample location maps, equipment maintenance documentation, chain-of-custody forms, and/or sample analysis request forms. Records may include, but are not limited to the following, as applicable:

- Sample Collection–To ensure maximum utility of the sampling effort and resulting data, documentation of sampling protocol, as performed in the field, is essential. Sample collection records may contain the names of persons conducting the activity, sample number, sample location, date and time the sample was taken, equipment used, climatic conditions, documentation of adherence to protocol, and unusual observations.

- Chain-of-Custody Records–The chain of custody involving the possession of RCRA characterization samples from the time they are obtained until they are disposed or shipped off-Site are documented, and may include the project name, signatures of samplers, sample number,

date and time of collection, grab or composite sample designation, signatures of individuals involved in sample transfer, and if applicable, the air bill or other shipping number.

- Quality Control (QC) Samples–Documentation for generation of QC samples, may include trip and equipment rinsate blanks, duplicate samples, and any field spikes.
- Deviations–All deviations from normal sampling and analysis protocols are recorded in the site logbook or project records.
- Reports–A copy of any report issued and any supporting documentation.

C-2c(2) Quality Control

Defensible and valid data are obtained through implementation of the processes controlling characterization and/or sampling and analysis. Such processes include the use of field and laboratory control samples, data validation, sampling performance assessments, and as necessary, corrective action(s) as identified in this section.

C-2c(2)(a) Field Control Samples

Control samples are QC samples that are intended to monitor the performance of the sampling system. In accordance with this WAP, the following field control samples may be collected:

- Field duplicates
- Equipment rinsate
- Trip blank-sample.

C-2c(2)(b) Laboratory Quality Control

Laboratories maintain QA programs to ensure the quality of data produced. Depending on the data end use and overall data quality objectives (DQOs), the laboratory QC samples may include:

- Matrix spike
- Matrix duplicate
- Matrix spike duplicate

- Laboratory blanks
- Control standards.

Off-Site laboratories must be approved by the INL. This approval process requires off-Site laboratories to pass stringent audit criteria included in the U.S. Department of Energy (DOE) Consolidated Audit Program (DOECAP). The DOECAP maintains audit checklists for such laboratory activities as general laboratory practices, quality assurance management systems, organic/inorganic data quality, radiochemistry data quality, electronic data management, hazardous and radioactive materials management, and industrial hygiene. These checklists are available to all facilities within the DOE Complex via the Internet. Once approved, laboratories are audited at regular intervals to ensure performance and QA/QC standards are met.

C-2c(2)(c) Data Validation

Depending on the data end use and overall project DQOs, data validation may include evaluation of the following subjects:

- Completeness of laboratory records with regard to processing of all required samples and analyses
- Implementation of appropriate procedures
- Evaluation of sample analytical data to required detection and quantity
- Evaluation of QC analytical data to applicable control criteria
- Comparison of sample holding times to the required holding times prescribed by this WAP.

All deviations from the applicable guidance are documented, and corrective actions are implemented as necessary.

C-2c(2)(d) Sampling Performance Assessment

A key function of a QC program is the periodic assessment of activities for conformance to required protocols. Sampling performance assessments may evaluate the following activities:

- Completeness of Field Reports–This evaluation determines that a complete record exists for each field activity and that the procedures specified by this WAP or the documents implementing this WAP were executed.

- Identification of Valid Samples–This review involves the evaluation and interpretation of field records to detect problems affecting the representativeness of samples.

All resultant concerns are documented, and corrective actions are implemented as necessary.

C-2c(2)(e) Mitigating Action

Mitigating action measures can be divided into two categories as follows:

- Project Mitigating Action–Mitigating actions are performed when the project objectives are not met, when conditions adverse to quality have been identified, or when an assessment of data reveals questionable or unknown data quality. Conditions adverse to quality are identified promptly, and corrected as soon as possible. When significant conditions adverse to quality are identified, the causes are determined, and mitigating actions to prevent their recurrence are performed and documented.

- Laboratory Mitigating Actions–The laboratory possesses a QA plan identifying analytical acceptance criteria and what actions to take when these criteria are not satisfied.

C-2d Frequency of Analyses: [IDAPA 58.01.05.008; 40 CFR § 264.13(b)(4)]

Waste stream characterizations are reviewed and recertified annually to ensure continued accuracy of the information provided. Typical waste streams managed at the INTEC are generated several times a year from highly controlled processes in which the waste composition remains consistent for the duration of the year. Recharacterization is required when:

- The process generating an established waste stream changes

- The waste characteristics are highly variable from batch to batch

- Analytical results do not correlate with waste profile information

- There is reason to suspect a change in the waste based on inconsistencies in the packaging or labeling of the wastes, or there are inconsistencies between the waste verification results and the waste characterization data provided by the generator

- Facility personnel reject the waste because it is inconsistent with the profile for that waste.

Facility personnel can require additional waste analysis to substantiate waste characterization data prior to acceptance of a waste.

C-2e Additional Requirements for Wastes Generated Off-Site [IDAPA 58.01.05.008; 40 CFR 264.13(c)]

The CSSF does not manage wastes generated off-Site.

C-2f Additional Requirements for Ignitable, Reactive, or Incompatible Wastes: [IDAPA 58.01.05.008; 40 CFR §§ 264.13(b)(6), 40 CFR 264.17]

Calcine generated by the treatment of wastes is a granular solid that does not exhibit the characteristics of ignitability or reactivity.

The CSSF storage units are operated in accordance with defined procedures that prevent incompatible wastes from contacting one-another. The tables in Appendix V of 40 CFR 264/265 and 49 CFR § 177.848 are examples of resources that may be used to determine compatibility. Since calcine was generated from the treatment of wastes with like or similar constituents, incompatibility is not a concern.

C-3 WASTE ANALYSIS REQUIREMENTS PERTAINING TO LAND DISPOSAL RESTRICTIONS [IDAPA 58.01.05.011; 40 CFR § 268]

The Hazardous and Solid Waste Amendments to RCRA authorize the land disposal of certain types of wastes only if LDR treatment standards are met. Information provided in this section describes the additional characterization requirements for assessing LDR applicability and compliance with the treatment standards before land disposal.

C-3a Waste Characterization

LDR applicability is determined for each waste at the point of generation based on the EPA HWNs assigned to individual waste streams. Once LDRs are identified, they remain applicable through

treatment and/or disposal of the final waste form. Calcine or the final waste form will be disposed of in accordance with applicable laws and regulations.

The characterization process for purposes of LDR is the same as that employed during the initial characterization process. Facility personnel, with the assistance of WGS, and other organizations as needed, conduct hazardous waste determinations before management of the waste. The hazardous waste determination includes, where applicable, EPA HWN determinations in addition to identification of wastewater and non-wastewater treatability groups, UHCs, LDR subcategories, and LDR treatment standards applicable to the waste.

During the initial characterization process, facility personnel select parameters and rationale for testing based on the rationale presented in Table C-2 and on the applicable LDR requirements found within IDAPA 58.01.05.011 and 40 CFR § 268 or process knowledge. If the waste is determined to be subject to the LDR requirements, facility personnel determine if the waste is a wastewater or non-wastewater, and also determine applicable subcategories. TOC and total suspended solids TSS analyses may be used to conduct wastewater/non-wastewater determinations, in cases where process knowledge is not adequate. Additional information on the characterization process is found in Sections C-1 and C-2.

Waste generated from activities such as maintenance and spill cleanup will undergo a hazardous waste determination based on testing and/or process knowledge as outlined within this document. If the waste is determined to be subject to LDR requirements, facility personnel will determine if the waste is a wastewater or non-wastewater and applicable subcategories using the parameters shown in Table C-2 or process knowledge.

C-3b Sampling and Analytical Procedures

Sampling and analysis will follow the same approach as outlined within Sections C-2 through C-2c. Test methods used to assess LDR treatment standards will be based on total analysis, unless otherwise specified in IDAPA 58.01.05.011 (40 CFR §§ 268.40 through 268.48).

C-3c Frequency of Analysis

Compliance with all LDR requirements will be demonstrated and documented prior to disposal of the final waste form. All LDR compliance documentation will be maintained in the facility operating record.

C-4 CALCINED SOLIDS STORAGE FACILITY SUBPART AA, SUBPART BB, AND SUBPART CC APPLICABILITY [IDAPA 58.01.05.008; 40 CFR §§ 264.1030, 264.1050, and 264.1080]

40 CFR 264 Subpart AA Applicability

The requirements contained in 40 CFR 264 Subpart AA do not apply to the CSSF, since it contains no process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations.

40 CFR 264 Subpart BB Applicability

The requirements contained in 40 CFR 264 Subpart BB do not apply to the CSSF, since the organic concentration of calcine is less than 10% by weight, as demonstrated by the analytical results provided as Appendix 3 of this permit reapplication.

40 CFR 264 Subpart CC Applicability

The requirements contained in 40 CFR 264 Subpart CC do not apply since the CSSF is a waste management unit used solely for the management of radioactive mixed waste in accordance with all applicable regulations under the authority of the Atomic Energy Act and the Nuclear Waste Policy Act and is specifically exempted per 40 CFR 264.1080(b)(6).

Attachment 3
Section F-1 Security

RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 3 - Section F-1
Security

May 2016

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F. PROCEDURES TO PREVENT HAZARDS

The waste management units addressed in this permit reapplication are designed and operated to minimize exposure of hazardous constituents to the general public, operating personnel, and the environment. This section describes the procedures and equipment/structures used at these units to help prevent, mitigate, or respond to environmental or human health hazards. Also described in this section are the inspection plans and schedules at these units to ensure proper maintenance and operation.

The waste management units addressed in this permit reapplication are calcined solids storage in tanks. These units are all located at the Idaho Nuclear Technology and Engineering Center (INTEC). Section D of this permit reapplication describes the operations of these units.

F-1. Security

F-1a. Security Procedures and Equipment [IDAPA 58.01.05.008 and 58.01.05.012; 40 CFR 264.14 and 270.14(b)(4)]

A security system, physical control procedures, and equipment control access to the INTEC. A security force under contract with the U.S. Department of Energy, Idaho Operations Office (DOE-ID), operates the security system. DOE-ID operates a personnel security clearance program to ensure that employees that are required to have a clearance to perform their duties are evaluated and cleared consistent with DOE-ID security policies.

Specific security measures taken for INTEC include fencing, warning signs, keycard access or personnel sign-in, and building locks.

Fencing, guarded gates and uniformed guards with communication devices are used at INTEC to provide facility security. There are communication devices in occupied buildings at the INTEC. The same communication devices may be used for communication outside the plant. The INTEC also has a plant-wide voice paging system that is used to announce critical information regarding security and safety.

F-1a(1) 24-Hour Surveillance System [IDAPA 58.01.05.008; 40 CFR 264.14(b)(1)]

Security at the INTEC is maintained by a staff of trained security guards, who monitor the entry and egress of people and material from the INTEC facility. The main INTEC guard gate at the west side of the INTEC is staffed with guards 24 hours a day, 7 days a week. There are other gates into the INTEC,

and they are either locked, staffed with guards, or keycard controlled. The guards perform other security functions within the plant premises, including patrolling the perimeter fence and areas throughout the INTEC on a 24-hour basis.

F-1a(2) Barrier and Means to Control Entry

The treatment, storage, or disposal facilities at INTEC are enclosed with a fence. All gates into INTEC are either locked or manned with security guards.

F-1a(2)(a) Barrier [IDAPA 58.01.05.008; 40 CFR 264.14(b)(2)(I)]

The INTEC facility is located approximately 42 air miles west of the largest nearby population area, Idaho Falls, Idaho. There are gates in the perimeter fences but only three are guarded gates. These gates are identified with the Guard Post (building) where they are located. The other gates are locked but can be opened by patrols when requested.

F-1a(2)(b) Means to Control Entry [IDAPA 58.01.05.008; 40 CFR 264.14(b)(2)(ii)]

Employees, sub-contractors, or vendors who have completed required access training and have keycard access are not escorted in the general INTEC interior.

Individuals who have the required access training but do not have key card access sign an "Employee Log" and are allowed into INTEC without being escorted.

Individuals that do not have the required access training and do not have keycard access are escorted and sign a "Visitor Log" to gain access to INTEC. These entry procedures into the INTEC prevent access into Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA)-regulated units by the general public and visitors.

For accountability reasons, all persons entering the INTEC must either enter through the card reader turnstile as they enter, or sign the INTEC entrance log ("Visitor Log" or "Employee Log" as applicable). When personnel leave the INTEC, they exit through the card reader turnstiles or sign out at the guard gate.

F-1a(3) Warning Signs [IDAPA 58.01.05.008; 40 CFR 264.14(c)]

Warning signs that are visible and legible from at least 25 ft are posted at guard gates and on the fence around the INTEC. Entrances into RCRA-regulated storage or treatment areas will have, at a minimum, signs reading "**DANGER**--Unauthorized Personnel Keep Out."

Attachment 4
Section F-2 Inspection
Schedule

RCRA PART B PERMIT

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 4 - Section F-2
Inspection Schedule

Revision Date: December 17, 2025

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F-2. Inspection Schedule

F-2a. General Inspection Requirements [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.14(b)(5), 264.15(a) and (b), 264.33, and 264.195]

The schedules for inspecting equipment vital in preventing, detecting, and responding to environmental or human health hazards are summarized in Appendix F-1. Results of inspections are recorded on the appropriate inspection forms, operating logs, or documented in reports. Copies of inspection records are placed in the appropriate RCRA inspection logs and are readily available at INTEC. These inspection records include the time and date of the inspection, the printed name and signature of the inspector, a notation of observations made, and the date and nature of any repairs or other remedial actions. The inspection forms show the inspections, frequencies, and responsibilities. Examples of these forms are provided in Appendix F-2. Other, similar forms containing the same substantive information may be used to document these inspections.

F-2a(1) Types of Problems [IDAPA 58.01.05.008; 40 CFR 264.15(b)(3)]

The inspection schedule in Appendix F-1 list types of problems looked for during inspections.

F-2a(2) Frequency of Inspection [IDAPA 58.01.05.008; 40 CFR 264.15(b)(4), (c), and (d)]

The frequency of inspections or observations, and the inspecting organization are listed in the schedule in Appendix F-1. Examples of Inspection Forms are found in Appendix F-2.

If a problem is found during an inspection, it is reviewed and confirmed by applicable supervision or system engineer and appropriate actions are taken. Environmental and facility personnel will work together to decide whether a remedial action is required, and plan the required action as necessary. Remedial actions are documented.

In those cases where an off-normal operational event (such as a ventilation upset and potential radioactive contamination) prevents access to an area where inspections are performed, a RCRA remedial will be opened and the remedial will be noted in the spaces on the inspection forms where the inspections or readings would normally be recorded. The RCRA remedial will be closed and inspections resumed, as soon as the upset conditions have been corrected and the area released for re-entry.

F-2b. Specific Process Inspection Requirements

F-2b(2) Tank System Inspection [IDAPA 58.01.05.008; 40 CFR 264.195 and 40 CFR 264.196]

Inspections of the tank systems will be performed using a remote camera in accordance with the schedule in Appendix F-1. The inspections will consist of visual observation via camera of the accessible portions of the exterior of the tanks for leaks, corrosion, and deterioration of tanks and vaults. The results of these inspections are documented in the facility's inspection records. The records are readily available at INTEC. The inspections will be recorded on inspection forms.

F-2b(2)(a) Certification for Tank Repairs [IDAPA 58.01.05.008; 40 CFR 264.196(f)]

If major repairs are made to the tank systems addressed in this permit reapplication, the repairs will be certified by a qualified, registered professional engineer (PE).

F-2b(2)(b) Tank System External Corrosion and Releases [IDAPA 58.01.05.008; 40 CFR 264.195(b)(1)]

The bins are contained in vaults that are constructed of concrete. The associated ancillary equipment is also within concrete containment.

The bins are monitored using instrumentation to detect leaks from the system. Confined spaces and radiation levels prevent visual inspections of these items on a daily basis. Inspections of the vaults are conducted in accordance with the schedule in Appendix F-1. Additional inspections via remote camera for bin sets 1 through 6 and a manned entry inspection of bin set 7, will be completed within 6 months after a significant earthquake (defined as a magnitude of 4.5 or greater on the Richter scale, as measured on the INL facility).

The aboveground portions of the tank system that can be inspected include the roofs of the bin set vaults, for bin sets 1 through 3 the earthen berms, and for bin sets 4 through 7 the exterior walls of the vaults. These portions are inspected for deterioration, spalling, or staining as appropriate. These inspections will be performed per the inspection schedule in Appendix F-1.

F-2b(2)(d) Tank System Overfilling Control Equipment [IDAPA 58.01.05.008; 40 CFR 264.195(a)]

Sump levels and CAM alarms are monitored on the Distributed Control System at the NWCF except for Bin Set 4. If there is a spill, leak, or process parameter outside of its normal range, an operator investigates, and notifies supervision.

For Bin Set 4, the sump level and CAM indicators and alarms are monitored locally in the instrument building (CPP-658). An increased sump level or alarm would be noted during daily operational readings.

The RCRA-mandated overfill and leak detection inspections are accomplished by monitoring process instrumentation that detects spills or leaks within a vault (see Appendix F-2 for inspection forms).

F-2b(2)(e) Tank System Monitoring and Leak Detection Equipment [IDAPA 58.01.05.008; 40 CFR 264.195(b)(2)]

The bin sets are equipped with CAMs to detect loss of bin containment. Any loss of containment would result in radioactive materials being suspended in the vault air that would be detected by the CAMs.

The RCRA-mandated overfill and leak detection inspections are accomplished by monitoring process instrumentation that detects spills or leaks within a vault (see Appendix F-2 for inspection forms).

F-2b(2)(g) Tank Condition Assessment [IDAPA 58.01.05.008; 40 CFR 264.195(b)(1)]

Bins and vaults are inspected or monitored for spills by monitoring the CAMs. In addition, a tank system integrity assessment titled *The Tank System Integrity Assessment for the Calcined Solids Storage Facility Bin Sets at the Idaho Nuclear Technology and Engineering Center*, prepared and certified by Jason Associates Corporation (see Appendix 2 of this permit reapplication), has determined that the calcine storage bins are adequately designed and have sufficient structural strength and compatibility with the wastes being stored to protect human health and the environment. The bin sets are not visually inspected on a daily basis due to confined spaces and high radiation levels.

Appendix F-1. Inspection Schedule for the CSSF

CSSF INSPECTION SCHEDULE

Equipment Inspection	Types of Problems or Observations	Frequency	Inspecting Organization
MONITORING EQUIPMENT INSPECTION – To ensure tank system is operating according to design			
Distributive Control System (DCS) Data for Sump Levels, CAMs	Operating, Not Alarming	Continuously	Shift Operations
CSSF #4 Local Sump and CAM instrumentation	Operating, Not Alarming	Daily	Shift Operations
CAMs Data	Operating, Not Alarming	Daily	Shift Operations
FIRE PROTECTION SYSTEM INSPECTIONS			
Portable Fire Extinguishers*	Physical damage, charge, accessibility and sealed	Monthly	Shift Operations
EMERGENCY EQUIPMENT INSPECTIONS			
Plant Voice Paging and Evacuation Alarm System	Operation, Coverage	Monthly	Plant Utilities/Operations
Communications Devices/Building Paging System	Operation at each Bin Set	Daily	Shift Operations
OPERATING AND STRUCTURAL EQUIPMENT			
Access warning signs	Warning signs in place – inside the INTEC facility Warning signs in place – INTEC perimeter fence and guard gates	Weekly Semiannually	Shift Operations Shift Operations
External and accessible portions of the vaults and ancillary equipment*	Deterioration, release of waste	Daily	Shift Operations
Area immediately surrounding the externally accessible portions of the piping*	Detect erosion, signs of a release	Daily	Shift Operations
Inside the vaults of Bin Sets 1 through 3, and Bin Set 1 filter vault (via camera)	Deterioration, release of waste	Every fifth year	Shift Operations
Complete inspection of Bin Set 7 (vault entry)	Deterioration	Annually	Shift Operations
Inside the vaults of Bin Sets 4 through 6 (via camera)	Deterioration, release of waste	Every fifth year	Shift Operations

***NOTE:** CSSF 7 is not currently subject to daily inspections as it contains no waste, and fire extinguishers are not present.

APPENDIX F-2. EXAMPLES OF INSPECTION FORMS

The following list of example inspection forms (current revision) are included:

Form INTEC-4010 (Rev. 32): RCRA CSSF Tank Overfill and Leak Daily Facility Inspections

Form INTEC-4023 (Rev. 11): RCRA CSSF Vault Inspections

Form INTEC-4028 (Rev. 33): RCRA CPP-659 Calciner/CSSF Monthly Emergency, DCS Alarm Functions, and Valve PL-122-5 Checks

Form INTEC-9123 (Rev. 9): RCRA LWFC Cell Inspection

Form INTEC-9123A (Rev. 5): Abbreviated RCRA Cell Inspection

Form INTEC-9124 (Rev. 15): RCRA LWFC Monthly Voice Paging/Evacuation System Inspections

TEM-6 (01/04/22 – Rev. 1)

This form is the current revision per EDMS.

Signature/Date

RCRA CSSF TANK OVERFILL AND LEAK DAILY FACILITY INSPECTIONS

Previous Week's Inspection Checked (Initials): _____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous week's form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

Date: _____ **Through** _____ **Time:**

Area/Item	Normal Condition	Off Spec. Condition	Thur	Fri	Sat	Sun	Mon	Tues	Wed
Solids Storage No. 1									
CAM-WCS-01 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
CAM-WCS-01 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
L-WCS-115-1	0–9 in. WC	>9 in. WC							
Signs in place? (4)	Yes	No						Yes/No	
Communication Device works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect earthen berm. (7)	No major soil displacement (No)	Major soil displacement (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Solids Storage No. 2									
CAM-WCS-02 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
CAM-WCS-02 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
L-WCS-742-1	0–45 in. WC	>45 in. WC							
L-WCS-742-1 air purge flow meters both indicate flow	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Signs in place? (4)	Yes	No						Yes/No	
Communication Device works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect earthen berm. (7)	No major soil displacement (No)	Major soil displacement (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes

RCRA CSSF TANK OVERFILL AND LEAK DAILY FACILITY INSPECTIONS

Area/Item	Normal Condition	Off Spec. Condition	Thur	Fri	Sat	Sun	Mon	Tues	Wed
Solids Storage No. 3									
CAM-WCS-03 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
CAM-WCS-03 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
L-WCS-746-1	0–45 in. WC	>45 in. WC							
L-WCS-746-1 air purge flow meters both indicate flow	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Signs in place? (4)	Yes	No						Yes/No	
Communication Device works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect earthen berm. (7)	No major soil displacement (No)	Major soil displacement (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Solids Storage No. 4									
CAM-WS4-01 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
CAM-WS4-01 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
LIA-WS4-1	0–6 in. WC	>6 in. WC							
Signs in place? (4)	Yes	No						Yes/No	
Phone works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes

RCRA CSSF TANK OVERFILL AND LEAK DAILY FACILITY INSPECTIONS

Area/Item	Normal Condition	Off Spec. Condition	Thur	Fri	Sat	Sun	Mon	Tues	Wed
Solids Storage No. 5									
CAM-WS5-02 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
CAM-WS5-02 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
L-WS5-1	0–20 in. WC	>20 in. WC							
L-WS5-1 air purge flow meters both indicate flow	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Signs in place? (4)	Yes	No						Yes/No	
Phone works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Solids Storage No. 6									
R-WS6-791-1 Operating	Operating (Yes) (1)	Not Operating (No)	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
R-WS6-791-1 alarm (2)	(Off or N/A) (3)	(On)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)	Off/On/ N/A (3)
L-WS6-1	Normal	High Alarm	Normal/ Hi	Normal/ Hi	Normal/ Hi	Normal/ Hi	Normal/ Hi	Normal/ Hi	Normal/ Hi
Signs in place? (4)	Yes	No						Yes/No	
Phone works?	Yes	No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
Inspect external and accessible areas of the vault and ancillary equipment. (5)(6)	No new visible deterioration or release of hazardous waste (No)	Either new visible deterioration or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes
Inspect externally accessible piping. (5)(6)	No visible erosion or release of hazardous waste (No)	Either new visible erosion or release of hazardous waste (Yes)	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes	No/Yes

(1) The iCAM is operating if: (a) the green AC POWER and MONITORING buttons are lighted, (b) the red ALARM and FAULT buttons are not lighted, (c) on the monitor screen the Airflow is greater than 20 L/min and Instrument Status is NORMAL, and (d) the RCTs have not tagged the iCAM as inoperable.
(2) This is due to a High-count rate.
(3) Circle "N/A" if the iCAM is not operating.
(4) "Danger - Unauthorized personnel keep out" signs.
(5) Accessible areas, for this inspection, are those that do not require (a) entering posted radiation or contamination control areas, other than Radiological Buffer Areas, (b) climbing above or below normal operating access levels, or (c) entering confined spaces.
(6) Inspect areas adjacent to Bin Set vaults and ancillary equipment without removal of soil, snow, or other environmental media.
(7) Inspect earthen berms from normally accessible areas without removal of snow or other environmental media.

RCRA CSSF TANK OVERFILL AND LEAK DAILY FACILITY INSPECTIONS

Form Review	Thur	Fri	Sat	Sun	Mon	Tues	Wed
Supervision Initials:							

Day	Inspector's Name (Print)	Inspector's Signature	Inspection Completed Date	Nature of Any Repairs or Other Remedial Actions	Repairs/Remedial Actions Complete or Not Required Supervision Signature/Date
Thur					
Fri					
Sat					
Sun					
Mon					
Tues					
Wed					

Comments: _____

Open RCRA Remedials on this form:

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

RCRA CSSF VAULT INSPECTIONS

TEM-6 (01/04/22 – Rev. 1)
This form is the current revision per EDMS.

_____
Signature/Date

Previous Inspection Checked (Initials): _____ Vault Inspected: _____ Date: _____ Time: _____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

Equipment/ Area Inspected	Types of Problems/Inspection Items	Observations	Nature of Any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions
Sump	Erosion, cracks, debris, settling, spills			
Sump jet	Steam leaks, debris			
Concrete floor	Cracks, deterioration, uneven settling, spills			
Concrete walls	Cracks, deterioration, settlement			
Tank exteriors	Corrosion, erosion, leaks, discoloration, buckles, bulges			
Piping	Corrosion, erosion, leaks, loose or corroded connections			
Valves	Leaks (internal and external), corrosion			
Ladders	Corroded, damaged, poor structural stability			

Comments: _____

RCRA CSSF VAULT INSPECTIONS

Open RCRA Remedials on this form:

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name (Print): _____

Inspector's Signature: _____

Inspection Completed;
Shift Supervisor's Signature: _____

Remedial Actions Completed
or Not Required;
Shift Supervisor's Signature: _____

RCRA CPP-659 CALCINER/CSSF MONTHLY EMERGENCY EQUIPMENT, DCS ALARM FUNCTIONS, AND VALVE PL-122-5 CHECKS

Signature/Date

Previous Month's Inspection Checked (Initials): _____ Date: _____ Time: _____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous month's form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

CSSF Fire Extinguishers

Check for accessibility, physical damage, sealed, and gauge indication in green (if equipped).

Location	Requirements Met		Problem(s) Found
SS I, Instrument Bldg.	Yes☐	No☐	
SS II, Instrument Bldg.	Yes☐	No☐	
SS III, Instrument Bldg.	Yes☐	No☐	
SS IV, Instrument Bldg.	Yes☐	No☐	
SS V, Roof	Yes☐	No☐	
SS V, Instrument Bldg.	Yes☐	No☐	
SS VI, Instrument Room	Yes☐	No☐	
SS VI, Roof	Yes☐	No☐	

NWCF Fire Extinguishers

Check for accessibility, physical damage, sealed, and gauge indication in green (if equipped) or red pop-up button down (if equipped).

Location	Requirements Met		Problem(s) Found
Room 423 East wall	Yes☐	No☐	
Corridor 424 East wall	Yes☐	No☐	
Room 601 East wall	Yes☐	No☐	
Room 426 West wall	Yes☐	No☐	
Room 427 Southwest wall	Yes☐	No☐	
Room 430 North wall	Yes☐	No☐	
Room 432 Northwest wall (there are 2 at this location)	Yes☐	No☐	
Corridor 409 South wall	Yes☐	No☐	
Room 433 West wall	Yes☐	No☐	
Room 438 East wall	Yes☐	No☐	
Room 438 Southwest wall	Yes☐	No☐	
Room 439 East wall	Yes☐	No☐	
Corridor 401 East wall	Yes☐	No☐	
Room 318 Southeast wall	Yes☐	No☐	
Room 318 West wall	Yes☐	No☐	
Room 311 Northeast wall	Yes☐	No☐	
Room 310 Northeast wall	Yes☐	No☐	
Room 311 Northwest wall	Yes☐	No☐	
Room 312 South wall	Yes☐	No☐	
Room 317 North wall	Yes☐	No☐	
Room 201 South wall	Yes☐	No☐	
Room 201 Southwest wall	Yes☐	No☐	

RCRA CPP-659 CALCINER/CSSF MONTHLY EMERGENCY EQUIPMENT, DCS ALARM FUNCTIONS, AND VALVE PL-122-5 CHECKS

Location	Requirements Met		Problem(s) Found
Room 209 East wall	Yes☐	No☐	
Room 211 East wall	Yes☐	No☐	
Room 211 West wall	Yes☐	No☐	
Room 212 Northeast wall	Yes☐	No☐	
Room 212 Northwest wall	Yes☐	No☐	
Room 217 Northeast wall	Yes☐	No☐	

Safety Showers/Eyewash Fountains

Check for leaks, accessibility, supply valve open, and that PM tag is current for the month being inspected.

Level	Location	Equipment No.	Requirements Met?	Problem(s) Found
First	Room 427	SSW-NWCF-10 EFN-NWCF-10	Yes ☐ No☐	
	Room 431	SSW-NWCF-14 EFN-NWCF-14	Yes ☐ No☐	
	Room 429	SSW-NWCF-1 EFN-NWCF-1	Yes ☐ No☐	
		SSW-NWCF-11 EFN-NWCF-11	Yes ☐ No☐	
Second	Room 318	SSW-NWCF-7 EFN-NWCF-7	Yes ☐ No☐	
	Room 312	SSW-NWCF-0 EFN-NWCF-0	Yes ☐ No☐	
Third	Room 201	SSW-NWCF-8 EFN-NWCF-8	Yes ☐ No☐	
	Room 211	SSW-NWCF-9 EFN-NWCF-9	Yes ☐ No☐	

Stretchers

Level	Location	Stretcher in Location?	Problem(s) Found
First	Room 409 – North wall	Yes ☐ No☐	
	Room 430 – South wall	Yes ☐ No☐	
Second	Room 317 – South wall	Yes ☐ No☐	
Third	Room 209 – South wall	Yes ☐ No☐	

Equipment/Item Inspected	Types of Problems/Inspection Items		Observations	Nature of Any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions
Safety showers/ eyewashes	Leaks, accessibility, supply valve open, PM tag current				
Spill control cabinets	Equipment inventory				
Equipment	**Normal Condition**	**Off Spec. Condition**			
Test Three DCS Alarm Functions	Audible and Visual Alarms	No audible and/or Visual Alarms	Alarms Do / Do Not Operate		
Room 204 Door (PL-122-5)	Sealed (Closed)	Seal broken (verify closed)	Previous Inspection Seal Number		
			Current Seal Number		

Valve PL-122-5 is verified closed prior to installation of seal on Room 204 door. If the seal number is the same and the seal has not been broken, then verifying position of PL-122-5 is not necessary.

RCRA CPP-659 CALCINER/CSSF MONTHLY EMERGENCY EQUIPMENT, DCS ALARM FUNCTIONS, AND VALVE PL-122-5 CHECKS

Spill Control Equipment Inventory

Cabinets are located in Room 431 (Chemical Makeup Room entry), Room 317 (second-level elevator entry), and Room 209 (third-level elevator entry).

Place "√" if minimum quantity (or greater) is present. Notify supervision of any usage so that cabinet can be restocked.
If seal number is the same and the seal has not been broken, an inventory needs only to be taken every other year, in the even years, during the July monthly inspection.

Item	Minimum Quantity Required	Room 431	Room 317	Room 209
Acid Boots **(1)**	6 pair (4pr – 2X, 2pr – 3X)			
Ty-Chem Acid Suits (yellow) **(1)**	12 (4 – 2X, 4 – 3X, 4 – 4X)			
Acid Gloves (neoprene) **(2)**	12 pair (6 – size 9, 6 – size 10)			
Splash Goggles	4			
Plastic Buckets	2			
Spill Control Pillows	24			
Hazardous Material Pigs	12			
Waste Bags **(2)**	12			
Mop Handles	1			
Mop Heads	3			
Safety Rope	25 ft			
Signs (5 total)	4 "Danger-Acid Spill" 1 "Chemical Spill"			
pH Paper **(2)**	2 boxes			
Duct Tape (white) **(2)**	2 rolls			
Shovel (flat head)	1			
Smear Paper and Envelopes	1 box			
Pencils, Grease Pencils	2 each			
Radiological Tags, Signs	5 each			
Acid Neutralizer	5-gallon bucket			
Caustic Neutralizer	5-gallon bucket			
Radiation Rope or Ribbon	25 feet			
	Previous Inspections Seal Number for Cabinet			
	Seal Number for Cabinet			

(1) Replace these items with new, out-of-the-box equipment, in July every four years, starting in 2018.

(2) Replace these items with new, out-of-the-box equipment, in July, in the even years.

RCRA CPP-659 CALCINER/CSSF MONTHLY EMERGENCY EQUIPMENT, DCS ALARM FUNCTIONS, AND VALVE PL-122-5 CHECKS

Open RCRA Remedials on this form:

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments	Nature of Any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions

Inspector's Name (Print): _____

Inspector's Signature: _____

Inspection Completed; Shift Supervisor's Signature: _____

Remedial Actions Completed or Not Required;
Shift Supervisor's Signature: _____

Comments: _____

RCRA LWFC CELL INSPECTIONS

Signature/Date

Previous Inspection Checked (Initial): _____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

Facility: _____ Cell Inspected: _____ Date: _____ Time: _____

A full inspection of the cell will be conducted when the cell is initially entered. If the cell remains open for more than 1 day (24 hours), and cell conditions have not changed, a cell inspection will be performed using either form INTEC-9123 or 9123A each day the cell is re-entered. If the cell remains open for 7 days or longer, then perform a full cell inspection every 7 days when entering the cell.

Equipment/Area Inspected	Types of Problems/Inspection Items	Observations	Nature of Any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions
Sump	Erosion, cracks, debris, settling, spills			
Sump jet	Steam leaks, debris			
Concrete floor (stainless lined)	Cracks, gaps, deterioration, uneven settling, spills			
Concrete walls (stainless lined)	Cracks, gaps, deterioration, settlement			
Concrete floor (epoxy painted)	Cracks, gaps, deterioration, uneven settling, spills, paint			
Concrete walls(1)	Cracks, deterioration, settlement, paint			
Tank exteriors	Corrosion, erosion, leaks, cracks, gaps, discoloration, buckles, bulges			
Piping	Corrosion, erosion, leaks, cracks, gaps, loose or corroded connections			
Valves	Leaks (internal and external), corrosion			
Cell door	Deterioration, corrosion, will not close			
Pumps (if any)	Corrosion, erosion, leaks, deterioration, loose connections			
Filter unit exterior	Deterioration, corrosion, bulges, buckles, leaks			

RCRA LWFC CELL INSPECTIONS

(1) The WL-161, Cell at INTEC-604 is known to have defects in the concrete walls above the stainless-steel liner. When this cell is inspected, compare the photos in EDF-6859, located on EDMS. If no change is noted, write NO CHANGE in the Observations section. No remedial actions will be necessary. If additional deterioration is noted, write this observation down and forward to the facility support engineer for further evaluation. Remedial action for this observation will be evaluated and repairs completed, if warranted.

Containerized Hazardous Waste Stored at Location?	Inspection if Waste is Stored at Location	Normal Condition	Off-Spec Condition	Inspection	Comments
Yes/No(2)	Containers leaking?	No	Yes	No/Yes	
	Containers deteriorating?	No	Yes	No/Yes	
	Containers closed?	Yes	No	Yes/No	
	Hazardous liquids on floor?	No	Yes	No/Yes	
	Deterioration visible (3)	No	Yes	No/Yes	

(2) Inspection is not required if containerized hazardous waste is not stored at location. Inspection is required on a weekly basis if containerized hazardous waste is stored at location.

(3) Inspect stainless steel containment liner on floor and walls for cracks, gaps, corrosion, and deterioration.

Comments: _____

_____

_____

_____

_____

Open RCRA Remedials on this form:

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name (Print): _____

Inspector's Signature: _____

Inspection Completed; Shift Supervisor's Signature: _____

Remedial Actions Completed or Not Required; Shift Supervisor's Signature: _____

ABBREVIATED RCRA CELL INSPECTION

TEM-6 (01/04/22 – Rev. 1)
This form is the current revision per EDMS.

Signature/Date

Previous Inspection Checked (Initials): _____

Cell Inspected: _____ Date: _____ Time: _____

The Open RCRA Remedials Tracking Book Index for this form has been compared to the previous inspection form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table (Initials): _____

Equipment/Area Inspected	Types of Problems/Inspection Items	Observations	Nature of Any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions
Sump(s), floor, walls, exterior tank surfaces, piping, valves, and pumps that are visible, and waste containers (1)	Erosion, deterioration, cracks, settling, leaks, spills, debris, or corrosion			

1. Abbreviated inspections may be performed by several means (e.g., cameras, observing the area through the cell entryway, walkthroughs, etc.). Walkthrough inspections completed by personnel performing work within the cell will be limited to those areas encountered while traversing between the cell entrance and the specific work location.

Containerized Hazardous Waste Stored at Location?	Inspection if Waste is Stored at Location	Normal Condition	Off-Spec Condition	Inspection	Comments
Yes/No(2)	Containers leaking?	No	Yes	No/Yes	
	Containers deteriorating?	No	Yes	No/Yes	
	Containers closed?	Yes	No	Yes/No	
	Hazardous liquids on floor?	No	Yes	No/Yes	
	Deterioration visible (3)	No	Yes	No/Yes	

2. Inspection is not required if containerized hazardous waste is not stored at location. Inspection is required on a weekly basis if containerized hazardous waste is stored at location.

3. Inspect stainless steel containment liner on floor and walls visible through shield window for cracks, gaps, corrosion, and deterioration.

ABBREVIATED RCRA CELL INSPECTION

Comments: _____

_____

_____

_____

_____

_____

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name (Print) _____

Inspector's Signature _____

Inspection Completed:
Shift Supervisor's Signature _____

Remedial Actions
Completed or Not Required:
Shift Supervisor's Signature _____

RCRA MONTHLY VOICE PAGING/EVACUATION SYSTEM INSPECTIONS

Signature/Date

Previous Inspection for this Facility Checked (Initials): _____ Date: _____ Time: _____

The Open RCRA Remedial Tracking Book Index for this form has been compared to the previous month's form, the index has been updated, and the current open RCRA Remedials have been recorded on the tracking table. (Initials): _____

NOTE 1: *The Voice Paging System and the Evacuation System use the same speakers.*

NOTE 2: *Use only one copy of this form as a "Master Copy." Ensure all areas checked are transferred to the Master Copy and keep a copy of the completed form at CPP-1683.*

Facility	Area Checked "√"(1)	Areas to Check	Requirements Met?(2)		Inspector's Initials
NWCF		All levels in the facility (including the Decon area)	Yes	No	
Waste Side		Tank Farm(3)	Yes	No	
		CPP-604/605 (all levels in the facility)	Yes	No	
		LET&D (all levels in the facility)	Yes	No	
		CPP-1683	Yes	No	
CPP-1617		Areas in CPP-1617	Yes	No	
Solids Storage Facilities		Solids Storage Facilities I, II, III, IV, V, VI(3)	Yes	No	

(1) Place a "√" in the "Area Checked" column to indicate which area(s) was inspected; leave the other boxes blank. Only fill in the "Requirements Met" section for the area(s) inspected:

(2) Requirements are met if the Voice Paging/Evacuation System is operational and can be heard throughout the normally accessible area(s) inspected. If an area is a high noise area, the requirements are met if the visual alarms are operational.

(3) Requirements are met if the Voice Paging/Evacuation System is operational and can be heard throughout the Tank Farm and the Solids Storage Facilities area(s).

RCRA MONTHLY VOICE PAGING/EVACUATION SYSTEM INSPECTIONS

List areas where system is not operating properly (if any):

Area Where System is Not Operating Properly	Nature of any Repairs or Other Remedial Actions	Completion Date for Repairs/Remedial Actions

Comments: _____

_____

_____

_____

_____

_____

_____

Open RCRA Remedials on this form:
Note: *The Open RCRA Remedial Tracking Index for this inspection form is maintained at CPP-1683.*

Footnote Letter	Tracking Number	Date Remedial was Identified	Deficiency Description/Comments

Inspector's Name (Print): _____

Inspector's Signature: _____

Inspection Completed - Shift Supervisor's Signature: _____

Remedial Actions Completed or NOT Required -
Shift Supervisor's Signature: _____

Attachment 5
Section H Personnel
Training

HMWA/RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22 – Idaho Nuclear Technology and Engineering Center
Calcine Solids Storage Facility

ATTACHMENT 5

Section H

Personnel Training

CONTENTS

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TABLES

Table H-1. Minimum Training Matrix for TSD Unit Personnel……. 6

H. PERSONNEL TRAINING

This section outlines and describes the training program for personnel involved in the management of hazardous and mixed waste at treatment, storage, and disposal (TSD) units at the Idaho Nuclear Technology and Engineering Center (INTEC), including units addressed in this permit.

A training program has been implemented to ensure that personnel involved in the management of hazardous and mixed waste at INTEC TSD units receive training consistent with the requirements of the Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 and 58.01.05.012 [Title 40 Code of Federal Regulations (CFR) Part 264.16 and 270.14]. The training program is designed to ensure that personnel are trained to hazardous waste management procedures including, but not limited to, inspections, normal operations, emergency procedures, equipment, systems, and contingency plan implementation. Duties performed at the TSD units will be performed in a safe, disciplined, and professional manner.

H-1. Outline of Training Program [IDAPA 58.01.05.008; 40 CFR 264.16(a)(1)]

Training programs are developed using a systematic approach to training (SAT). The SAT process involves:

- Analyzing tasks to determine the training requirements
- Designing a plan to satisfy the training requirements
- Developing plans and all supporting training materials
- Implementing the training plans
- Evaluating the effectiveness of the training and making recommendations for changes.

The SAT process is used to determine the training requirement for each task listed in Table H-1. The training program for TSD unit personnel involves a combination of formal [classroom, group instruction, on-the-job training (OJT), etc.] and informal training sessions (one-on-one instruction,

required reading, etc.). The training requirements for each position are identified in Table H-1. Lesson plans and OJT guides are developed to support tasks identified in Table H-1.

Programs prepared by the TSD training organization provide the requirements to be completed by the individual during training. As the program is satisfactorily completed, it is verified and documented in their training records.

The training program is upgraded as needed in response to changes in job descriptions, job reassignment, process or procedural changes, technological changes, or implementation of new regulatory requirements that affect TSD unit operations. Revisions to the training program are approved by the training manager and the TSD unit manager (training director) for the specific TSD unit and the job analysis data is updated to reflect the changes in the training requirements.

TSD unit management works with subject matter experts to identify personnel training requirements. The TSD unit training organization (1) schedules and/or provides the training, (2) revises and updates training material as needed, and (3) maintains training documentation. The TSD unit training organization maintains individual training records for TSD unit employees.

H-1a. Job Tasks [IDAPA 58.01.05.008; 40 CFR 264.16(d)(1), 264.16(d)(2)]

The job tasks for personnel involved with hazardous waste management at INTEC TSD units are included in Table H-1 "Minimum Training Matrix for TSD unit Personnel" Personnel are trained to those sections of the permit, which are pertinent to their specific job assignments.

Security Guards – The Security personnel are not stationed at the permitted units nor are they involved in the management or handling of the waste. Security personnel receive training from the security organization relative to their positions and the facilities they serve. Therefore, training of security personnel is not discussed further in this section.

On Scene Commander – is the senior responding Idaho National Laboratory (INL) Fire Department officer. The INL Firefighters serve the INL Site in fighting fires and containing major spills, including spills of waste from waste management units. The INL Fire Department conducts a self-contained training program for their personnel, which includes procedures for handling fires and spill

emergencies involving hazardous materials and hazardous mixed waste at the INL Site. Therefore, training of fire fighters is not discussed further in this section.

Emergency Director (ED) – is trained on the INL (Site-wide) and Idaho Completion Project (ICP) Emergency Plan (EP)/Resource Conservation and Recovery Act (RCRA) Contingency Plan (CP) or Industrial Safety and Hygiene Program as part of his/her duties. The ED will be informed by the Emergency Action Manager (EAM) or facility personnel at INTEC. Therefore, training of ED is not discussed further in this section.

H-1b. Training Content, Frequency, and Techniques [IDAPA 58.01.05.008; 40 CFR 264.16 and (d)(3)]

The TSD unit training program consists of a combination of classroom instruction and OJT. Additionally, TSD unit employees receive new employee orientation and training. [All employees working at or assigned as part-time/frequent visitor to Site facilities are required to complete annual facility access training and general employee radiation training (GERT) unless they are currently trained as radiation workers.]

The initial training includes a general orientation of INL and TSD unit procedures including evacuation and alert procedures, training requirements, and emergency equipment locations. The initial training provides TSD unit personnel with training commensurate with their job assignments in the following areas:

- General description of the INTEC
- Job-related procedures, policies, and instructions
- Radiological health and safety program
- Fire protection program
- Hazards associated with the TSD unit.

RCRA training is conducted annually for INTEC TSD unit employees to address changes that have occurred which include such topics as permit status, permit requirements, contingency and inspection plan implementation, and hazardous waste management procedures for the TSD unit(s) to which they are assigned.

The following major knowledge areas are included and evaluated based on job position and formal criteria identified in the job analysis:

- RCRA requirements as they relate to INTEC unit operations
- Hazardous materials
- INTEC TSD unit systems and components (including waste treatment processes and operations)
- Normal operating procedures and shutdown procedures
- Emergency or off-normal operating procedures
- Inspections and equipment maintenance
- Occupational Safety and Health Administration (OSHA) and related health and safety requirements
- INTEC TSD unit and operational/administrative procedures.

TSD unit work and maintenance is performed by appropriate personnel whose qualifications have been verified before beginning work.

Employees may be given written and/or oral examinations, operational evaluations, and reviews to ensure that they are adequately trained relative to their job tasks. Results of examinations, written or oral evaluations, and reviews are documented. All completed qualification standards, checklists, examinations, written evaluations, and documented oral evaluations are maintained in each individual's training record.

Table H-1 shows the task training requirements for TSD unit personnel involved in hazardous/mixed waste operations at INTEC TSD units addressed in this permit. TSD unit personnel may receive additional training beyond that shown in Table H-1. This training is documented and included in employee training records.

Occasionally, TSD unit personnel attend training classes conducted external to the INL or conducted at the INL Site by non-INL subcontract personnel. In order to verify an employee's attendance at these training courses, a copy of the class certification or other documentation is maintained in the individual's training record.

H-1c. Training Director [IDAPA 58.01.05.008; 40 CFR 264.16(a)(2)]

For all TSD units, the facility manager (training director) functions in conjunction with his/her designee(s) to insure that all segments and responsibilities associated with the training program are accomplished. The training director provides overall leadership and management direction to the TSD unit training organization. The director's duties include the following:

- Provide direction to the TSD unit training organization
- Ensure that performance of training personnel is evaluated
- Approve TSD unit training program
- Ensure that all program objectives and requirements are satisfied and that the training program meets the requirements of IDAPA 58.01.05.008 (40 CFR 264.16) and 29 CFR 1910.120.

The training director or his/her designee(s) is responsible for ensuring that TSD unit personnel are trained in waste management and contingency plan implementation, including emergency procedures, and for ensuring that TSD unit personnel receive training appropriate to their tasks. The training director also reviews documentation, including feedback from audits, operating logs, emergency exercise critiques, and employee recommendations, for possible inclusion into the TSD unit training programs.

Table H-1. Minimum Training Matrix for TSD Unit Personnel.

TASK	AUDIENCE	INITIAL EMPLOYEE TRAINING	RAD TRAINING[1]	24-HOUR OSHA[1]	ANNUAL TRAINING	APPLICABLE SECTIONS OF RCRA PERMIT[2]
INTEC operations personnel that perform treatment, storage, and disposal facility (TSDF) operations and inspections, or supervise those operations, and are exposed to the hazards of the TSDF. These employees have duties that may bring them into contact with hazardous/ mixed waste. These employees are required to obtain 24-hr HAZWOPER TSDF Qualification.	INTEC RCRA Worker	X	X	X	X	C, D, F, G
Personnel who enter TSDF areas unescorted and provide support functions that may require them to interface with systems, structures, or components referenced within the facility RCRA Permit, or may bring them into contact with hazards of the facility to include the potential for exposure to hazardous/mixed waste at the TSDF. These employees are required to obtain 24-hour HAZWOPER TSDF Qualification. Examples of work activities include radiological surveys, inspections, waste characterization, performing waste shipments or waste movement, repairing or replacing facility emergency/monitoring equipment, life safety systems support, equipment calibrations, and surveillance. Examples of work that may be included are Quality Inspectors, Quality Engineers, System Engineers (assigned to TSDFs), Life Safety System Engineers, Environmental Engineers, Industrial Hygienists, Safety Engineers, Packaging and Transportation representatives, Waste Technical Specialists, Crafts (instrument technician, pipefitter, mechanic, welder, painter, etc.) and Radiological Control Technicians.	INTEC RCRA Technical Support Worker-HAZWOPER	X	X	X	X	F, G

Table H-1. (continued)

TASK	AUDIENCE	INITIAL EMPLOYEE TRAINING	RAD TRAINING[1]	24-HOUR OSHA[1]	ANNUAL TRAINING	APPLICABLE SECTIONS OF RCRA PERMIT[2]
Personnel who enter TSDF areas unescorted and provide support functions that may require the individual to interface with systems, structures, or components referenced within the facility RCRA Permit. Personnel in this category generally do not have the potential to for exposure to the hazardous or mixed waste (for instance, these employees are not required to wear PPE and are not required to complete 24-hour HAZWOPER training). Examples of workers that may be included are System Engineers (not assigned to TSDFs), and other personnel who perform the activities listed above.	INTEC RCRA Technical Support Worker	X	X		X	F, G
Personnel who enter TSDF areas unescorted and provide only incidental support to facility operations. These individuals are not directly exposed to the hazards of the TSDF but must be cognizant of the RCRA-related requirements for access. Additionally, these personnel are not required to complete 24-hour HAZWOPER training. Examples of positions within this level include Maintenance Planners, Radiological Engineers, RCT Supervision, personnel assigned as Senior Supervisory Watch, Training Specialists, Waste Disposition Specialists, D&D Workers and administrative support personnel.	INTEC RCRA General Employee	X			X	F, G
INTEC EAM conducts operations-related response; coordinates protective actions or protective action recommendations; authorizes response resources; satisfies federal, state, and local requirements and declares the INTEC Emergency Control Center operational.	INTEC Emergency Action Managers	X	X	X	X	G

[1]. Personnel who do not have the potential for exposure to the hazards of the regulated units may not require this training.

[2]. Personnel receive training related to the permit section as appropriate to their job function.

Section C – Waste Characterization
Section D – Process Information
Section F – Procedures to Prevent Hazards
Section G – Preparedness, Prevention, and Contingency Plan

H-1d. Relevance of Training to Job Tasks [IDAPA 58.01.05.008; 40 CFR 264.16(a)(2)]

Individual training program profiles are prepared for each TSD unit position that requires a formal training program.

At a minimum, each individual training program profile identifies the following:

- Job description
- Qualifications
- Training requirements.

Profiles typically identify qualification requirements. Occasionally, a position may require specialized training. Special-case training is documented in individual training records. Profiles include requirements for hazardous/mixed waste management or handling and emergency response training.

Supervisors have the responsibility for evaluating training requirements for TSD employees. These supervisors receive additional training in how to conduct and evaluate OJT.

Individuals who demonstrate an equivalency for specific requirements or prerequisites identified in the training profile may be exempted from requirements in accordance with established procedures. Exemptions/equivalencies must be approved by the training director. Each exemption/equivalency is granted in writing and documented in the individual's training record.

H-1e. Training for Emergency Response [IDAPA 58.01.05.008; 40 CFR 264.16(a)(3)]

Emergency response training is provided to all personnel assigned to or associated with TSD units, including specialized training for employees with specific emergency action responsibilities, such as the EAM and Emergency Response Organization (ERO) personnel. The following presents an overview of the emergency response training.

General emergency response training of TSD unit ERO personnel includes training on the ICP EP/RCRA CP which covers the following topics:

- Spill Control Plan
- Evacuation/accountability
- Emergency drill/exercise
- RCRA
- Emergency Plan Implementing Procedures
- Emergency preparedness
- Incident command system
- Inspection and repair of facility emergency monitoring equipment.

ERO members respond to emergency events. ERO members receive initial training and annual requalification training, in addition to training provided to general employees. Training of ERO members is outlined by position in company procedures. All INTEC employees receive general employee emergency response action training.

H-2. Implementation of Training Program [IDAPA 58.01.05.008; 40 CFR 264.16(b), 264.16(d)(4), 264.16(e)]

After completion of new employee orientation, designated employees enter a training program specific to their job assignment. Persons holding qualifications are retrained and reevaluated as mandated by procedures. Job assignments which are required for the completion of a training program have time and performance limitations that must be satisfied to meet program qualification criteria.

RCRA training is completed within the first six months of the individual's employment or assignment, and at least annually thereafter, for positions involving TSD unit operations. Throughout the training program and until completion, employees do not perform their job duties unsupervised.

H-3. Training Records [IDAPA 58.01.05.008; 40 CFR 264.16(d)(4) and (e)]

Individual training records are maintained for personnel assigned to TSD units. Training records include documentation of completed training, such as class rosters, signed checklists, completed exams, data base printouts from additional training classes attended, and other documents verifying training. The original training records are maintained by the presenting organizations, which enter course completion information into a database. A hard copy of this information is also entered into the individual's training record.

The training records include the names of employees filling each TSD unit position. Job tasks and associated training requirements for each TSD unit are found in Table H-1.

Individual training records include, as a minimum, the following:

- Initial training and retraining programs
- Attendance records of training received
- Results of exams, walk through, and job performance assessments related to certification.

Training records for current employees at each TSD unit are maintained until closure of the unit or the employee terminates or transfers to a non-TSD unit position. The training records of terminating employees are maintained at the TSD unit for a minimum of three years from the date the employee last worked at a TSD unit. The training records for TSD unit employees who transfer to a non-TSD unit position within the company are forwarded to the employee's new organization where they continue to be available for at least three years.

Attachment 6
Sections F-3, F-4, F-5
Procedures to Prevent Hazards

RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 6 - Sections F-3, F-4, and F-5
Procedures to Prevent Hazards

May 2016

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F-3. Documentation of Preparedness and Prevention Requirements

F-3a. Equipment Requirements [IDAPA 58.01.05.012 and 58.01.05.008; 264.32]

F-3a(1) Internal Communications [IDAPA 58.01.05.008; 40 CFR 264.32(a) and 264.34]

In any event (fire, explosion or release), the person involved/discovering can activate the nearest manual alarms and use communication devices (e.g., two-way radio, alarm system, etc.) to summon assistance, and make notifications to the plant shift supervisor/Emergency Action Manager (EAM) and/or the INL Fire Department. The INTEC EAM will ensure that all facility personnel are being, or have been, notified of the imminent or actual emergency situation, including a confirmation call to the Warning Communications Center (WCC), to verify the INL Fire Department is responding.

The CSSF buildings are equipped with communication devices (e.g., two-way radios, etc.) capable of summoning emergency assistance. The personnel involved in the operation have immediate access to emergency communication devices. If there is ever just one employee at the TSD while the unit is operating, that employee will be provided immediate access to a communication device for summoning emergency assistance.

F-3a(2) External Communications [IDAPA 58.01.05.008; 40 CFR 264.32(b)]

The CSSF buildings are equipped with communication devices (e.g., two-way radios, etc.) capable of summoning emergency assistance. The INTEC EAM and the WCC use communication devices that provide direct access to external emergency response agencies.

F-3a(3) Emergency Equipment [IDAPA 58.01.05.008; 40 CFR 264.32(c)]

The emergency/safety equipment located in the buildings associated with the CSSF includes the following:

- Portable fire extinguishers
- Emergency lighting.

Portable fire extinguishers are located in/near the instrument room of each Bin Set (except Bin Set 7 as there is no waste present). Extinguishers are inspected monthly, to ensure that they are charged, sealed, and accessible.

F-3a(4) Water for Fire Control [IDAPA 58.01.05.008; 40 CFR 264.32(d)]

The INTEC fire water distribution system is designed with redundant components. Water is supplied to the underground fire water distribution piping by two identical above-ground storage tanks (VES-UTI-111 and VES-UTI-112) each with a nominal capacity of 623,925 gal. The tanks are kept continually full by two deep wells (WEL-UTI-501 and WEL-UTI-502) located in CPP-611 and CPP-612, each equipped with electric motors. Pressure is maintained on the fire water distribution piping with two electric jockey pumps located in CPP-606. The jockey pumps are not designed to supply fire water to the building suppression systems if there is significant demand for water. Fire water is supplied by one of two diesel-driven fire pumps located in CPP-1642 and CPP-1643.

F-4. Preventive Procedures, Structures, and Equipment

F-4a. Unloading Operations [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(i)]

There are no unloading operations associated with the CSSF.

F-4b. Run-off [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(ii)]

The units addressed in this permit reapplication are located within fully enclosed vaults. The area surrounding each vault slopes away from the vault, carrying any storm water toward the streets, where the water is collected and diverted away from the vault as demonstrated by Appendix 1 to Section B of this permit reapplication. The CSSF are outside of the 100-year floodplain boundary as postulated in the Big Lost River Flood Hazard Study, November 2005 (see the current revision of the Volume 3 of the INL Permit Application). Additionally, there is no threat of contact between storm water and waste that could contaminate other areas, since all wastes are contained inside stainless steel bins within vaults.

F-4c. Water Supplies [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(iii)]

Building features such as high-density concrete base and leak detection prevents contamination of water supplies by calcine spills.

F-4d. Equipment and Power Failure [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(iv)]

Power failure requirements are applicable, but not of a concern, since there are no power-operated waste management activities at the Bin Sets. Battery-powered emergency lights are located in buildings that support Bin Sets 4, 5, 6, and 7 to provide lighting for personnel during a power failure. Buildings that support Bin Sets 1, 2, and 3 are too small to need emergency lighting. The CAMs in Bin Sets 1, 2, and 3 are not on standby power. After a power failure, radiological control technicians (RCTs) ensure the CAMs are operating and no failures have occurred. The CAMs in bin sets 4, 5, 6, and 7 are on a standby power circuit to allow monitoring during a power outage.

F-4e. Personnel Protection Equipment [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(v)]

The buildings are designed with various features that prevent undue exposure of personnel to mixed waste. CAMs and surveys performed by RCTs are used to monitor all areas and aid in the detection of contamination. Operations are conducted according to written procedures. See Section F-3a(3) of this permit reapplication for a list of equipment available for emergency use, and see Section G, the contingency plan of this permit reapplication, for a description of the locations of this equipment.

Pre-job briefings are held, as necessary, to ensure understanding of procedures, safety hazards, and radiological concerns.

F-4f. Releases to the Atmosphere [IDAPA 58.01.05.012; 40 CFR 270.14(b)(8)(vi)]

All of the vaults cooling air inlet dampers and outlet dampers have been physically disabled in the closed position to prevent operation or have been blind flanged. These actions have isolated the vaults from the atmosphere. In the event of an airborne release from a bin, the vault will contain any airborne material.

F-5. Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes

No ignitable or reactive wastes are stored in the CSSF. Waste compatibility was verified prior to treatment in the calciners. No additional compatibility testing was performed for wastes stored in the CSSF.

Attachment 7
Section G Contingency Plan

RCRA PART B PERMIT

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 7 - Section G
Preparedness, Prevention, and Contingency Plan

Revision Date: December 17, 2025

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G-1 General Information 40 CFR 264.51 Purpose and implementation of Contingency Plan. (a) Each owner or operator must have a Contingency Plan for his facility. The Contingency Plan must be designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water.	**G-1 General Information** The Idaho Nuclear Technology and Engineering Center (INTEC) is designed, constructed, and operated to exclude or isolate hazardous incidents such as fires, explosions and/or unplanned sudden or nonsudden releases of mixed or hazardous waste or hazardous waste constituents to air, soil, or surface water. The INTEC location, operation, site plan and descriptions/information are presented in detail in Section B, Facility Description. This Resource Conservation and Recovery Act (RCRA) contingency plan matrix discusses emergency response at the INTEC. This matrix addresses emergency actions to protect human health, the environment, and INTEC facilities and equipment in an event originating from or affecting the permitted units, comprised of the Calcined Solids Storage Facility (CSSF). The Idaho National Laboratory (INL) Emergency Plan/RCRA Contingency Plan (INL EP/RCRA CP) is the implementing document for emergency response across the INL and is written to comply with requirements that are in addition to those of the Idaho Hazardous Waste Management Act (HWMA)/RCRA. This matrix provides the HWMA/RCRA contingency plan requirements that are being implemented through the INL EP/RCRA CP.
(b) The provisions of the plan must be carried out immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.	The contingency plan outlines the response to emergencies that occur in personnel accessible areas. However, emergencies that involve the inside of the CSSF tanks and vaults will be monitored from outside of the vaults. Due to high radiation levels (between 180 and 380 R/hr fields in CSSF 1 that should be comparable with all the vaults except CSSF 7) the vaults will not be entered until the calcine is removed at closure.
40 CFR 264.53 Copies of Contingency Plan A copy of the Contingency Plan and all revisions to the Contingency Plan must be:	The contingency plan is designed to provide the proper preparation and necessary response planning to prevent or minimize hazards to human health and the environment from fires, explosions, or any release of hazardous waste or hazardous waste constituents. The provisions of the contingency plan are carried out immediately whenever a fire, explosion, spill, or release of hazardous waste or hazardous waste constituents that could threaten human health or the environment occurs. Facility personnel trained according to the provisions of this plan manage minor incidents that can be controlled with on-Site resources and do not threaten human health or the environment. Such responses are not considered activation of the contingency plan.
(a) Maintained at the facility; and	The contingency plan, with all subsequent revisions, will be maintained with the RCRA permit at the facility at various locations, including the Plant Shift Supervisor's office.
(b) Submitted to all local police departments, fire departments, hospitals, and State and local emergency response teams that may be called upon to provide	Copies of the contingency plan are maintained on-Site, with copies provided to the following through Memoranda of Understanding (MOUs) and Memoranda of Agreement (MOAs) with the DOE Idaho Operations Office (DOE-ID):

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emergency services.	• Bingham, Bonneville, Butte, Clark, and Jefferson County Sheriffs' Departments and City of Idaho Falls Police Department • Madison County, City of Ammon, City of Chubbuck, and City of Idaho Falls Fire Departments, South Custer Rural, Shelley/Firth Fire Districts, and Central Fire District and Teton County Protection District • Portneuf Medical Center, Eastern Idaho Regional Medical Center, and Bingham County Memorial Hospital • Bingham County Emergency Management Services, Bonneville County Emergency Management Services, Butte County Emergency Services, Clark County Civil Defense, and Jefferson County Emergency Management • Shoshone-Bannock Tribes • Bureau of Land Management and Department of Interior • State of Idaho and Idaho Transportation Department
40 CFR 264.54 Amendment of the Contingency Plan. The Contingency Plan must be reviewed, and immediately amended, if necessary, whenever:	The contingency plan is reviewed and immediately amended, if necessary, whenever:
(a) The facility permit is revised;	• The HWMA/RCRA permit is modified.
(b) The plan fails in an emergency;	• The contingency plan fails in an emergency.
(c) The facility changes in its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency;	• It is determined/known that changes in the permitted units' design, construction, operation, maintenance, or other circumstances have taken place in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency.
(d) The list of emergency coordinators changes; or	• The list of INTEC emergency action managers (EAMs) changes (refer to Section G-2, Emergency Coordinators).
(e) The list of emergency equipment changes.	• The list of emergency equipment changes (refer to Section G-5, Emergency Equipment).
G-2 Emergency Coordinators **40 CFR 264.52(d) and 264.55** 40 CFR 264.52(d) The plan must list names, addresses, and phone numbers (office and home) of all persons qualified to act as emergency coordinator (see 264.55), and this list must be kept up to date. Where	**G-2 Emergency Coordinators** The Emergency Action Managers (EAMs), listed below, are the emergency coordinators (ECs) for purposes of HWMA/RCRA compliance with respect to the contingency plan. Due to the shift-work structure and remoteness of the INTEC, it is not possible or practical for one individual to assume "primary" responsibilities.

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more than one person is listed, one must be named as primary emergency coordinator and the others must be listed in the order in which they will assume responsibility as alternates. For new facilities, this information must be supplied to the Regional Administrator at the time of certification, rather than the time of permit application.	The responsibility is best assigned through "redundant primary" EAMs, without alternates. Names, home addresses, and home phone numbers of the INTEC EAMs are as follows: • Pettingill, Michael D. – 1211 N 1100 E, Shelley, ID 83274; 208-681-7599 (home/cell); 208-521-0883 (work) • Schmitt, Virgil G. – 3897 Nathan Dr., Idaho Falls, ID 83404; 208-201-7272 (home/cell); 208-521-0883 (work) • Johnson, Staci L. – 1492 N 800 E, Shelley, ID 83274; 208-520-2687 (home/cell); 208-521-0883 (work) • Webb, Jarvis L. – 3863 N McKibben Ln., Iona, ID 83427; 208-403-5289 (home/cell); 208-521-0883 (work) • Angelo, Joseph A. – 445 E 700 N, Firth, ID 83236; 208-716-7140 (home/cell); 208-360-3736 (work) • Clancy, Nicholas A. – 933 E. Wyeth St., Pocatello, ID 83201; 843-367-1688 (home/cell); 208-360-3736 (work) • Johnson, Michael C. – 3382 Grove Ln., Idaho Falls, ID 83404; 208-716-9167 (home/cell); 208-360-3736 (work) • Wiebe, Jeff K.* – 212 N 12th Ave., Pocatello, ID 83201; 208-244-4107 (home/cell); 208-360-3736 (work) • O'Brien, Russell L. – 950 South 2600 West, Sterling, ID 83210; 208-252-2234 (home/cell); 208-360-3736 (work) • Doffing, Gregory P.* – 3916 Orchard Circle, Ammon, ID 83406; 208-286-4690 (home/cell); 208-360-3736 (work) * indicates alternate The business address (1580 Sawtelle St., Idaho Falls, Idaho 83402) is the same for all the EAMs. The EAM list above is subject to change due to changes in personnel. The current list of EAMs is maintained in Appendix I of the INTEC Addendum to the ICP EP/RCRA CP (PLN-2012).
40 CFR 264.55 Emergency Coordinator. At all times, there must be at least one employee either on the facility premises or on call (i.e., available to respond to an emergency by reaching the facility within a short period of time) with the responsibility for coordinating all emergency response measures. This emergency coordinator must be thoroughly familiar with all aspects of the facility's Contingency Plan, all operations and activities at the facility, the location and characteristics of the waste handled, the location of all records within the facility, and the facility layout. In addition, this person must have the authority to commit the resources needed to carry out the Contingency Plan.	An INTEC EAM is at the INTEC at all times or on call. All of the INTEC EAMs are thoroughly familiar with all aspects of the contingency plan, all INTEC operations/activities (including these units), the location and characteristics of waste handled, volumes of waste, the location of all records within the INTEC and layout. All of the INTEC EAMs have the authority to commit the necessary resources to carry out the contingency plan. The INTEC EAMs are responsible for: • Ensuring that the emergency procedures are implemented and completed when responding to any incident involving the units permitted herein to mitigate or eliminate any immediate or potential hazard to personnel, the public, or the environment • Serving as the primary lead in coordinating with the INL Fire Department, INL Emergency Operations Center (EOC), and the INL Warning Communications Center (WCC) for the proper support from these organizations • Delegating authority to the INTEC Emergency Response Organization

	(ERO), as well as the On-Scene Commander (OSC), as appropriate. If an incident overlaps more than one shift, the active INTEC EAM shall maintain the command until responsibility is officially passed to the incoming INTEC EAM.

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G-3 Implementation 40 CFR 264.52(a) and 264.56(d)	**G-3 Implementation**
40 CFR 264.52(a) The Contingency Plan must describe the actions facility personnel must take to comply with 264.51 and 264.56 in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the facility.	The provisions of the contingency plan will be carried out immediately whenever there is a fire, explosion, or unplanned release of hazardous or mixed waste or hazardous waste constituents that threaten human health or the environment (activation of the contingency plan). Such an occurrence (incident) requires classification, as described below, to aid in expediting the appropriate emergency response.
40 CFR 264.51 *[The text of 40 CFR 264.51 is located in Section G-1, General Information.]*	Classification of an occurrence is done in accordance with DOE Orders. Through these orders, the DOE has established definitions for occurrence categories and emergency classes. Occurrences are categorized by severity, in order of increasing severity.
40 CFR 264.56 Emergency procedures. (a) *[The text of 40 CFR 264.56(a) is located in Section G-4a, Notification.]* (b) *[The text of 40 CFR 264.56(b) is located in Section G-4b, Identification of Hazardous Materials.]* (c) *[The text of 40 CFR 264.56(c) is located in Section G-4c, Assessment.]* *(d) If the emergency coordinator determines that the facility has had a release, fire, or explosion which could threaten human health, or the environment, outside the facility, he must report his findings as follows:* (1) If his assessment indicates that evacuation of local areas may be advisable, he must immediately notify appropriate local authorities. He must be available to help appropriate officials decide whether local areas should be evacuated; and	An operational emergency at the INTEC may require response from the INTEC ERO, or support agencies, because the occurrence involves either an actual or potential fire or explosion involving mixed waste, or an uncontrolled release or threat of an uncontrolled release of mixed waste or constituents. Operational emergencies are defined as an unplanned significant event or condition that requires time-urgent response from outside the immediate/affected area of the incident. An operational emergency shall be declared when events have seriously degraded, or have the potential to degrade, the safety or security of the INTEC. Operational emergencies are classified by severity for specifying the appropriate emergency response actions and notifications, which are commensurate with the degree of hazard for the emergency. Classification aids in the rapid communication of critical information and the initiation of appropriate time-urgent emergency response action. The three classes of operational emergencies, in order of increasing severity, are: **ALERT.** Alert shall be declared when events are predicted, are in progress, or have occurred that result in either: • An actual or potential substantial degradation in the level of control over hazardous materials (radiological and nonradiological) OR

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(2) He must immediately notify either the government official designated as the on-scene coordinator for that geographical area, (in the applicable regional contingency plan under part 1510 of this title) or the National Response Center (using their 24-hour toll free number 800/424-8802). The report must include: (i) Name and telephone number of reporter; (ii) Name and address of facility; (iii) Time and type of incident (e.g., release, fire); (iv) Name and quantity of material(s) involved, to the extent known; (v) The extent of injuries, if any; and (vi) The possible hazards to human health, or the environment, outside the facility.	• An actual or potential substantial degradation in the level of safety or security of a facility or process that could, with further degradation, produce a site area emergency or a general emergency. If an actual or potential substantial degradation in the level of control over hazardous materials (radiological and nonradiological) occurs, the radiation dose from any release to the environment of radioactive material or a concentration in air of other hazardous material is expected to exceed either: • The applicable Protective Action Guide (PAG) or Emergency Response Planning Guideline (ERPG) at or beyond 30 m from the point of release to the environment OR • Ten percent of the applicable PAG or 10% of the ERPG-2 (TEEL-2) value at 100 m AND It is not expected that the applicable PAG or ERPG will be exceeded at or beyond the facility boundary or exclusion zone boundary. **SITE AREA EMERGENCY.** A site area emergency shall be declared when events are predicted, are in progress, or have occurred that result in either: • An actual or potential major failure of functions necessary for the protection of worker or the public OR • An actual or potential major degradation in the level of safety or security of a facility or process that could, with further degradation, produce a general emergency AND The radiation dose from any release of radioactive material or concentration in air from any release of other hazardous material is not expected to exceed the applicable PAG or ERPG at or beyond the site boundary. **GENERAL EMERGENCY.** A general site emergency shall be declared when events are predicted, are in progress or have occurred that result in either:

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	• Catastrophic reduction of facility safety or security systems with a potential for the release of large quantities of hazardous materials (radiological or nonradiological) to the environment actually occurring or imminent OR • The radiation dose from any release of radioactive material or a concentration in air from any release of other hazardous material is expected to exceed the applicable PAG or ERPG at or beyond the site boundary. The following is a list of personnel and organizations with a general description of their actions/responsibilities in response to fires, explosions, or unplanned sudden or nonsudden releases of hazardous waste or hazardous waste constituents to air, soil, or surface water: • Operations Personnel – Ensure personal safety, inform plant shift supervisor of situation/emergency (type of emergency, location, size, material(s) involved, status of other waste materials, equipment, etc.), and, if possible and properly trained, stop waste movements, secure area, and initiate efforts to stabilize the situation • Plant Shift Supervisor/EAM – Sound appropriate alarms, gather information/documents, responsible for conducting emergency response within the INTEC and the immediate implementation of the contingency plan • INL Fire Department – Primary responders to all fires and hazardous incidents, providing fire fighting, hazardous materials (HAZMAT) response, and emergency medical services • INTEC Emergency Response Organization – Trained facility personnel including the INTEC EAM • On-Scene Commander (OSC) – With the assistance of the INTEC EAM, assesses situation from the standpoint of tactical deployment of the INL Fire Department and overall effort to address the situation/emergency • INL Emergency Operations Center (EOC) – Provides support to the INTEC ERO, including dose assessment, off-Site notifications, public information, and other technical/tactical functions that aid in the assessment, control, and return to operations • Emergency Director (ED) – Manages the INL EOC and has jurisdiction over all INL operational emergency response activities • INL Warning Communications Center (WCC) – Serves as the central organization for coordinating efforts between INL EROs and off-Site agencies/support services • Industrial Hygienist – Assists in the assessment of hazards/risk (such as monitor areas with known/suspected high concentrations of hazardous vapors/gases) and appropriate response actions • Waste Technical Specialist – Assists in the identification of waste/materials, proper adsorbent/absorbent, and post-emergency collection, storage, treatment and/or disposal • Central Facilities Area (CFA) EAM – Assists INTEC EAM where required/requested to assess possible effects beyond the perimeter of the

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	INTEC, in which case he would assume a responsibility role. Specific actions which further address 40 CFR 264.52(a) and 264.56(d) are described in Section G-4, Emergency Response Procedures.
G-4 Emergency Response Procedures **G-4a Notification 40 CFR 264.56(a)** 40 CFR 264.56(a) Whenever there is an imminent or actual emergency situation, the emergency coordinator (or his designee when the emergency coordinator is on call) must immediately: (1) Activate internal facility alarms or communications systems, where applicable, to notify all facility personnel; and	**G-4 Emergency Response Procedures** **G-4a Notification** In the event of a fire or explosion, fire detection equipment (smoke detectors, heat detectors, water flow alarms, or water sprinkler alarms) will automatically notify the Fire Alarm Center (FAC), which will involve the INL Fire Department and personnel located within the building where the alarm was activated. In any event (fire, explosion or release), the person involved/discovering can activate the nearest manual alarms and use communication devices (such as cell phones, hand-held two way radios) to summon assistance, and make notifications to the plant shift supervisor/EAM and/or the INL Fire Department. The INTEC EAM will ensure that all facility personnel are being, or have been, notified of the imminent or actual emergency situation, including a confirmation call to the WCC, to verify the INL Fire Department is responding. All notifications shall include the following information, as appropriate: • Name and telephone number of the caller • Location of the incident and the caller • Time and type of incident • Severity of the incident • Description of the incident • Cause of the incident, if known • Assistance needed to deal with or control the incident • Name and address of the facility • Name and quantity of material(s) involved, to the extent known • Extent of injuries, if any • Possible hazards to human health, or the environment, outside the facility. Once the EAM is notified of a fire, explosion, or uncontrolled release at the INTEC (by either an eyewitness or an alarm), the EAM will activate the contingency plan. If necessary, the EAM will also request assistance from the INL Fire Department. The INL Fire Department is contacted by dialing 777 or 526-7777. In case of fire, the INL Fire Department will respond to the alarms. The nature of any incident potentially involving hazardous waste or hazardous materials will undergo assessment, as described in Section G-4c. The contingency plan will not be activated if the incident is considered minor and does not constitute an emergency requiring notification of regulatory agencies (such as a fire, explosion, or natural occurrence that does not involve or threaten hazardous or mixed wastes; a release that does not constitute a potential threat to human health or the environment; a spill contained in secondary containment; and/or a spill or release that is less than a reportable quantity specified in 40 CFR 302.4). Reportable quantities under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA) apply to the release of any substance listed in

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	Table 302.4 of 40 CFR Part 302. The INTEC maintains its own emergency response capabilities through the ERO. There are adequate supplies, equipment, and trained personnel available at the INTEC to mitigate expected emergencies. The INL Fire Department and security personnel operate separately, but their activities are coordinated through the EAM. DOE-ID maintains coordination and mutual aid agreements with local outside agencies who make additional emergency personnel and equipment available if outside assistance is required. In addition, as a DOE facility, the staff at the INTEC can call upon the resources of the INL EOC for additional assistance, including, but not limited to, MOU agreements with local agencies (such as outside medical facilities or state and local law enforcement agencies) and other federal agencies. (See Section G-1.) **Communication of Emergency Conditions to Facility Employees** The procedures for notifying facility personnel depend on the type and severity of emergency and may include the following: • Local Fire Alarms – In the event of a fire, these may be activated automatically or manually. • Evacuation – The evacuation signal is an alternating, siren tone, manually activated by the contract security force, or the INTEC Emergency Control Center, at the direction of the EAM. If the primary warning system consisting of alarms and signals fails to operate when activated (as in a total power outage and failure of the backup power systems), security will be directed by the EAM to use voice amplifiers to alert personnel to evacuate the area. • INTEC Voice Paging System – The INTEC voice paging system provides personnel with general and emergency information.
(2) Notify appropriate State or local agencies with designated response roles if their help is needed.	**Notification of Local, State, and Federal Authorities** If it is determined that the permitted units have had a fire, explosion, spill, or release of hazardous waste or hazardous waste constituents, or an emergency resulting in a release of a hazardous substance included in 40 CFR 302.4, that could threaten human health or the environment inside or outside the INTEC, the contingency plan will be activated. The EAM will ensure that local authorities are notified by phone and/or facsimile. Based on the initial information provided by the EAM or the ED these notifications are made by the INL WCC. The agencies to be contacted include, as appropriate: <u>County Dispatch Centers</u>: <u>Butte County</u> (208) 527-3585 Fax Number (208) 527-3916 <u>Bonneville County</u> (208) 522-1644 or (208) 529-1200 Fax Number (208) 529-1153

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	Bingham County (208) 785-7653 Fax Number (208) 785-8067 Clark County (208) 374-5669 Fax Number (208) 374-5614 Fort Hall Police Dispatch (208) 233-7451 Public Safety (208) 237-0137 Fax Number (208) 478-4005 Jefferson County (208) 745-9207 Fax Number (208) 745-9212 DOE-HQ Emergency Operations Center (202) 586-8100 Fax Number (202) 586-8485 State of Idaho Communications Center (800) 632-8000 or (208)846-7610 Fax Number (208) 846-7620 National Response Center 1-800-424-8802 The first notification of regulatory agencies will include, as appropriate: • Name and address of the facility and the name and phone number of the reporter • Type of incident: fire, explosion, release, etc. • Date and time of the incident • Type and quantity of hazardous material(s) involved • Exact location of the incident • Injuries, if any • Possible hazards to human health and the environment (air, soil, water, wildlife, etc.) outside the facility • Name, address, and telephone number of the party in charge of or responsible for the facility or activity associated with the incident • Steps being taken or proposed to contain and clean up the material involved in the incident. The ED and EAM will also be available to help the appropriate local, state, or federal officials decide whether local areas should be evacuated. **Notification of the General Public** The INL Emergency Director or the EAM will notify the general public through the public safety and emergency agencies listed above. DOE policy is to provide accurate and timely information to the public, by the most expeditious means possible, concerning emergency situations that may affect

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	employees, off-Site personnel, public health and safety, and/or the environment.
G-4b Identification of Hazardous Materials 40 CFR 264.56(b) 40 CFR 264.56(b) Whenever there is a release, fire, or explosion, the emergency coordinator must immediately identify the character, exact source, amount, and areal extent of any released materials. He may do this by observation or review of facility records or manifests, and, if necessary, by chemical analysis.	**G-4b Identification of Hazardous Materials** The identification of hazardous wastes or hazardous waste constituents involved in a fire, explosion, or release to the environment is a necessary part of the assessment of an incident. RCRA-regulated hazardous waste and hazardous substances and materials listed in 40 CFR 302.4 involved in any release at the permitted units will be identified. In normal storage configuration, the CSSF provides for protection of human health and the environment by isolating the calcined waste from the environment and INTEC personnel. The INTEC EAM will determine the identity, exact source, amount, and extent of any released materials. Sources of information include, but may not be limited to: • Observations of personnel involved in or discovering the situation • Permitted units operating records • Material safety data sheets (MSDSs) • Monitoring performed by an industrial hygienist • The INL Fire Department's findings/reports. Released or residual materials (residuals from a fire or explosion) that cannot be identified by labels, records, logbooks, identification numbers, or electronic databases will be sampled in accordance with a waste analysis plan (WAP), and analyzed to determine the chemical properties of the waste. The analytical results will determine the proper disposition of unidentifiable waste materials.
G-4c Assessment 40 CFR 264.56(c) and 264.56(d) 40 CFR 264.56(c) Concurrently, the emergency coordinator must assess possible hazards to human health or the environment that may result from the release, fire, or explosion. This assessment must consider both direct and indirect effects of the release, fire, or explosion (e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire and heat-induced explosions). 40 CFR 264.56(d) *[The text of 40 CFR 264.56(d) is located in Section G-3, Implementation.]*	**G-4c Assessment** Once the required notifications have been made, the EAM will ensure the identity, exact source, amount, and extent of released materials spreading from the event location can be determined. Individuals entering the affected area to gather information for the assessment will wear appropriate personal protective equipment (PPE). Robotic equipment and/or portable shielding may be used to determine and reduce the radiological hazards from released waste to protect INTEC personnel. The EAM will determine the identity of materials released, based on knowledge of the area and access to the waste identification/characterization information described in Section G-4b. After the materials involved in an emergency are identified, the specific information on the associated hazards, appropriate PPE, decontamination method, etc., will be obtained from MSDSs or other appropriate chemical reference materials.

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	Based on default conservative estimates of potential source terms, emergency action levels (EALs) have been developed for fires, explosions, radiological releases, and other emergency events. EALs are specific, predetermined, observable criteria used to determine the emergency classification and initial protective actions for operational emergencies. These EALs provide guidance for activating the INL EROs at the appropriate level in response to the incident. These EALs specify the initial protective actions (that is, evacuation or take cover) to be taken in response to the event. The emergency assessment requires determination of hazards involving evaluation of several criteria, including the following: • Nature of the accident – Known or probable cause; current/projected status of the affected area; facility conditions; status of containment boundaries/systems; type(s) and quantities of hazardous waste/material (nonradiological and radiological) involved in the incident • Weather conditions, present and expected – Wind speed and direction; precipitation; time of day; stability class; weather forecast; anticipated dispersion pattern; direction of travel and width of plume; locations affected • Exposure – Magnitude of actual or potential exposure to employees, the general public, and the environment; duration of human and environmental exposure; pathways of exposure • Toxicity – Types of adverse health or environmental effects associated with exposures; the relationship between the magnitude of exposure and adverse effects • Reactivity (if applicable) – Hazardous materials or wastes involved in an incident will be assessed through accessing the MSDSs for the affected material to determine its reactivity and the recommended method(s) for managing such waste • Effects – Direct and indirect effects of the release, fire, or explosion (such as the effects of any toxic, irritating or asphyxiating gases that are generated, or the effects of any hazardous surface water run-off from water or chemical agents used to control fire or explosions) • Uncertainties – Considerations for undeterminable or future exposures; uncertain or unknown health effects including future health effects. If the assessment indicates no real or potential threat to human health or the environment, the occurrence will be considered a minor incident. Minor incidents do not require further activation of the contingency plan. If the assessment indicates that a potential threat exists to off-Site human health or the environment due to airborne contaminants, the EAM or ED will advise the appropriate off-Site response personnel of the nature of the potential threat. Wind data for the INTEC and the nature of the wastes normally stored at the permitted units do not indicate that an airborne release is likely to occur outside the CSSF.

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G-4d Control Procedures **40 CFR 264.52(a)** 40 CFR 264.52(a) The Contingency Plan must describe the actions facility personnel must take to comply with 264.51 and 264.56 in response to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the facility.	**G-4d Control Procedures** **Fires and Explosions and Releases** • Design of the binsets eliminates fire and explosion within the vaults (see Section G-4e). • Personnel at INTEC do not enter the CSSF vaults because of the radiological hazards. If a release within the vaults is detected by the CAMs, additional radiological characterization will be conducted. This characterization will be completed using radiological instrumentation that can be lowered into the vaults though instrumentation ports. This will allow for radiological characterization of the released waste while still providing adequate protection of human health and the environment. In addition, this monitoring can be completed at multiple points in time to assess whether waste continues to be released within the vaults or if the radiological conditions within the vault have stabilized. In any case, personnel will not enter the vaults to complete cleanup of released materials. The released materials will be removed from the vault as part of the calcine retrieval operations in preparation for treatment or final disposal. **Natural Phenomena Emergencies** After any natural emergency (earthquake, flood, lightning strike, etc.) that may have affected the permitted units, the EAM shall ensure the following actions are performed as appropriate: • Check to ensure all automatic and manual alarms in the permitted units are working if feasible • Conduct a general survey of the exterior of the permitted units looking for potential problems (including radiological characterization) • Take any necessary corrective measures, however temporary, to rectify potential or real problems • Record all inspection results. **Power Failure** Should power fail, battery-operated lights will automatically illuminate. In the event of a power failure, personnel will secure any work in progress and leave the area until power is restored. The utilities have backup power replacements as shown: • Lights – Fixed battery-operated lights will operate • Alarms – Emergency communication and fire alarm systems have battery backup • Communication Devices – cell phone and/or radio networks will be used

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G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases 40 CFR 264.56(e) and (f) 40 CFR 264.56(e) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous waste at the facility. These measures must include where applicable, stopping processes and operations, collecting and containing release waste, and removing or isolating containers. 40 CFR 264.56(f) If the facility stops operations in response to a fire, explosion, or release, the emergency coordinator must monitor for leaks, pressure buildup, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.	**G-4e Prevention of Recurrence or Spread of Fires, Explosions, or Releases** **Equipment Failure** There will be no impact to the permitted units from an equipment failure. Maintenance personnel will repair mechanical failures that do not result in spills. During an emergency, the EAM will ensure that reasonable measures are taken so that fires, explosions, and releases do not occur, recur, or spread to mixed waste or other hazardous materials at the facility. These measures may include the following as appropriate: • Stopping processes and operations • Collecting and containing released wastes and materials • Removing or isolating containers of waste or hazardous materials • Ensuring wastes managed during an emergency are handled, stored, or treated with due consideration for compatibility with other wastes and materials onsite and with any containers utilized (see Section G-4g) • Restricting personnel not needed for response activities from the area of the incident • Evacuating the area if necessary • Curtailing nonessential activities in the area • Conducting preliminary inspections of adjacent facilities and equipment to assess damage • Over-packing and/or removing damaged containers/drums from affected areas • Repairing damaged equipment and facilities, as appropriate • Constructing, monitoring, and reinforcing temporary dikes, as needed. As described in Section G-4a above, once the EAM is notified (by either an eyewitness or alarm) of a fire, explosion, or release, the EAM will immediately report the situation to the WCC and take action to notify the INL Fire Department and ERO, as necessary. If necessary, the EAM may request other INL support. All personnel not involved in combating the emergency shall evacuate the affected area and assemble in designated locations away from the affected area as informed by the EAM by appropriate means. Emergencies originating at the permitted units will be addressed by activation of the contingency plan under the direction of the EAM. The contingency plan may be activated at any time, at the discretion of the EAM. **Fires** The design of the bin sets eliminated combustible loading within the vaults therefore, fires within the vaults themselves will not occur. Fires that occur outside the vaults will be addressed as follows. Fires that involve or threaten hazardous or mixed wastes are considered emergencies for the purposes of the contingency plan. Planned actions include:

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	• The INL Fire Department will be contacted by pulling the fire-alarm call box or by dialing 777 or 526-7777 • Fire fighting personnel will don appropriate PPE • If the fire is small and the fuel source is small, portable fire extinguishers may be used to put out the fire • Whenever possible, flammable material will be removed from the area of the fire • If the fire spreads or increases in intensity, all personnel will be evacuated to an upwind location • The EAM will remain in contact with responding personnel to advise them of the known hazards • As necessary, actions will be taken to ensure storm drains do not receive potentially hazardous run-off. Dikes will be built around storm drains and any valves controlling discharge will be closed. The EAM is responsible for all emergency response actions conducted within the facility, supporting and coordinating with the On-Scene Commander and for the overall mitigation of the event until the emergency event is terminated. Selection of methods and tactics of fire fighting is the responsibility of the INL Fire Department. An absorbent will be poured over all chemical residues resulting from a hazardous waste fire. Once the liquid is absorbed, the waste will be swept or shoveled back into containers, and the surface will be cleaned using cleaners appropriate to the identified chemicals. Fire fighting waters will be collected and analyzed, whenever possible, to determine an appropriate disposal method. **Explosions** The design of the bin sets eliminated the potential for explosions; therefore explosions within the vaults themselves will not occur. Explosions that occur outside the vaults will be addressed as follows. Explosions that involve or threaten hazardous or mixed waste or an explosion that is imminent are considered emergencies for the purposes of the contingency plan. Planned actions include: • The area will be immediately evacuated. • Any injured personnel will be immediately transported to the appropriate medical facility for treatment. • The EAM will immediately notify the appropriate emergency response personnel and the WCC about the explosion. • The EAM will remain in contact with responding personnel to advise them of the known hazards involved and the degree and location of the explosion and associated fires. • The EAM is responsible for all emergency response actions conducted within the facility, supporting and coordinating with the On-Scene Commander and for the overall mitigation of the event until the emergency event is terminated. Selections of methods and tactics of responding to an explosion are the responsibility of the On-Scene Commander.

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	• An adsorbent/absorbent will be poured over all chemical residues resulting from a hazardous waste explosion. Once the liquid is absorbed, the waste will be swept or shoveled back into the drums, and the surface cleaned using cleaners appropriate to the identified chemicals. • The EAM will ensure all operational units are secured (e.g., process equipment, and ventilation equipment) that may be affected directly or indirectly by the explosion, once the areas have been determined safe for reentry. **Releases** Released materials within the vaults are addressed in Section G-4d. Any other releases that occur outside the vaults will be addressed as follows. The EAM will implement the following, as appropriate, in the event that: (a) a hazardous or mixed waste or hazardous material spill causes an immediate health hazard; (b) a hazardous or mixed waste or hazardous material spill cannot be contained with secondary containment or application of absorbents; or (c) a threat exists for spilled material to move out of the permitted units: • Evacuate the immediate area • Review facility records to determine the identity and chemical nature of released material • Don appropriate PPE to prevent exposure to the material • Secure the source of the release, if possible • Build a dike to contain run-off • Ensure storm drains do not receive potentially hazardous run-off or spill material • Build dikes around storm drains or close any valves controlling discharge • Collect and contain released wastes by stabilizing or neutralizing the spilled material, as appropriate, pouring an absorbent over the spilled material, and sweeping or shoveling the absorbed material into drums or other appropriate containers • Ensure that waste that may be incompatible with the released material will be managed in the affected area until cleanup procedures are complete. After collection of a released material, the incident location will be sampled and evaluated. If contamination is found to exist, contaminated materials may be collected, drummed (if appropriate), and removed from the area for disposal at a permitted disposal facility. Depending on the specific conditions, however, INTEC personnel may choose to implement an alternative decontamination method, such as surface cleaning or in situ neutralization or stabilization. Any such alternative will be discussed with the Director of the Idaho Department of Environmental Quality, before implementation.

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G-4f Storage and Treatment of Released Materials 40 CFR 264.56(g) 40 CFR 264.56(g) Immediately after an emergency, the emergency coordinator must provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material that results from a release, fire, or explosion at the facility.	**G-4f Storage and Treatment of Released Materials** Once initial spill containment has been completed, the EAM will ensure that recovered hazardous materials and waste are properly stored, treated, and/or disposed of, as required by IDAPA 58.01.05.006; 58.01.05.007; and 58.01.05.008 (40 CFR 262, 263, and 264). For spills of liquid that escaped secondary containment, the perimeter of the spill will be diked with an absorbent material, such as absorbent pillows, that is compatible with the material(s) released. Freestanding liquid will be transferred to a labeled compatible container. The remaining liquid will be absorbed with an absorbent material and swept or scooped into a labeled compatible container. Spill residue will be removed. Spills of dry material will be swept or shoveled into a labeled compatible recovery container. Material recovered from the spill will be transferred to a new or clean-washed container. All containers will meet Department of Transportation (DOT) specifications for shipping the recovered wastes and materials. Hazardous waste resulting from the cleanup of a fire, explosion, or release will be contained and managed as a hazardous waste until such time that it can be determined that the waste is not hazardous, as defined in IDAPA 58.01.05.005 (40 CFR 261, Subparts C and D). In most cases, the hazardous waste inventory logs completed when containers are placed in storage at the permitted units will allow a determination of the hazardous wastes and hazardous waste constituents present in any cleanup of a release or the residues from an emergency condition. When necessary, however, samples of the waste will be collected and analyzed to determine the presence of any hazardous characteristics and/or hazardous waste constituents; this information is needed to evaluate disposal options. Approved sampling and analytical methods will be used. If the entire permitted unit has been impacted because of a fire, explosion, or spill, pending decontamination, no hazardous or mixed waste will be accepted for storage or treatment, until it is restored to design status. All cleanup and decontamination residues will be packaged, handled, and stored according to applicable state or federal regulations, DOE orders, and permitted unit procedures. During this period, storage will occur at a less-than-90-day storage site. All liquid wastes will be provided with secondary containment. If unaffected areas of the permitted unit can be used, containers of waste from the affected area(s) will be cleaned, over-packed, placed in spill pans, or transferred to new containers and moved to the unaffected areas.

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	The contaminated area will be decontaminated. If the release results in contamination to a permeable surface, such as soil, asphalt, or other surface, the material will be removed and placed in DOT-approved shipping containers. Contaminated surface materials, as well as materials used in the cleanup (such as rags and absorbent material), will be containerized and placed into storage, pending transfer to an on- or off-Site treatment or disposal facility, in accordance with applicable regulations.
G-4g Incompatible Waste 40 CFR 264.56(h)(1) 40 CFR 264.56(h) The emergency coordinator must ensure that, in the affected area(s) of the facility: (1) No waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed; and	**G-4g Incompatible Waste** In the event of a hazardous material or hazardous waste release, the EAM will ensure that no wastes will be received, treated, or stored in the affected areas until cleanup operations have been completed. This will ensure that incompatible waste will not be present in the vicinity of the release. If waste is generated as the result of a spill or release of hazardous materials or hazardous waste, the waste generated as a result of abatement and cleanup will be evaluated to determine its compatibility with other wastes being managed in temporary storage areas. The evaluation will identify the material or waste that was spilled or released and determine its characteristics (ignitable, reactive, corrosive, and toxic). The waste generated by the abatement and cleanup activities will be stored in that part of the temporary storage area of the permitted units that has been established to manage wastes with which it is compatible. Administrative controls, such as installing barriers and/or a cordon around the temporary storage area(s), will be implemented to ensure segregation of wastes. The EAM will not allow hazardous or mixed waste operations to resume in a building or area in which incompatible materials have been released before ensuring that necessary postemergency cleanup operations to remove potentially incompatible materials have been completed.
G-4h Post-Emergency Equipment Maintenance 40 CFR 264.56(h)(2) 40 CFR 264.56(h) The emergency coordinator must ensure that, in the affected area(s) of the facility: (2) All emergency equipment listed in the CP is cleaned and fit for its intended use before operations are resumed.	**G-4h Postemergency Equipment Maintenance** The EAM will ensure that emergency equipment is cleaned and ready for its intended use before operations are resumed. Any equipment that cannot be decontaminated may be discarded as waste (that is, hazardous, mixed, solid, as appropriate). Equipment or supplies that cannot be reused following an emergency will be replaced. After the equipment has been cleaned, repaired, or replaced, a postemergency facility and equipment inspection will be performed, and the results will be recorded. Cleaning and decontaminating equipment may be accomplished using nonhazardous materials whenever possible, by physically removing gross or solid residue, rinsing with water or another nonhazardous liquid, and/or washing with detergent and water. Decontamination and cleaning will be conducted in a confined area, such as a wash pad or building equipped with a floor drain and sump isolated from the environment. Care will be taken to prevent wind dispersion of particles and spray. Liquid or particulate resulting from cleaning and decontamination of equipment will be placed in clean, compatible containers. Waste resulting from decontamination

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	operations will be analyzed for hazardous waste constituents and/or hazardous waste characteristics to determine proper management. When INTEC facility personnel have completed any post-emergency cleanup of waste and hazardous residues and waste management operations are ready to resume, the EAM will ensure the following have occurred: • All emergency equipment used in managing the emergency has been cleaned or replaced and is fit for service • Notification of the Director of the Department of Environmental Quality and any relevant local authorities. This postemergency notification complies with IDAPA 58.01.05.008; [40 CFR 264.56(i)].
G-4j Tank Spills and Leakage 40 CFR 264.194 (c) 40 CFR 264.194(c) The owner or operator must comply with 264.196 if a leak or a spill occurs in the tank system. 40 CFR 264.196 Response to leaks or spills and disposition of leaking or unfit-for-use tank systems. A tank system or secondary containment system from which there has been a leak or spill, or which is unfit for use, must be removed from service immediately, and the owner or operator must satisfy the following requirements: (a) Cessation of use; prevent flow or addition of wastes. The owner or operator must immediately stop the flow of hazardous waste into the tank system or secondary containment system and inspect the system to determine the cause of the release. (b) Removal of waste from tank system or secondary containment system. (1) If the release was from the tank system, the owner/operator must, within 24 hours after detection of the leak or, if the owner/operator demonstrates that it is not possible, at the earliest practicable time, remove as much of the waste as is necessary to prevent further release of hazardous waste to the environment and to allow inspection and repair of the tank system to be performed.	**G-4j Tank Spills and Leakage** In addressing this section, it is important to realize that the INTEC buildings are designed, constructed and remotely operated to exclude or isolate hazardous incidents. In the case of the permitted tank systems (tanks and ancillary equipment), all are contained within a completely enclosed, self-supporting structure that is designed and constructed of manmade materials of sufficient strength and thickness to support themselves, the waste contents, and personnel and heavy equipment that may operate within the building(s). When a spill or leak from a tank system is encountered, the plant shift supervisor/EAM will assess the situation, and determine the proper and safe action(s), if any, necessary to best stop the spill or leak (e.g., stop the flow of waste into or out of the tank). Additional waste will not be added to the tank. All of the subject tanks are mixed waste tanks and radiological considerations will in most cases impede efforts to remove the waste from the tank. However, the waste will be addressed in as timely a manner as possible to prevent harm to human health and the environment while ensuring the safety of the facility personnel responding to the spill/leak. After ensuring personnel safety, the most important task is to identify the source of the spill/leak and the actual and potential extent of the leak/spill, for example: • A minor leak from ancillary equipment (a pump or valve, that can be easily stopped/controlled) • A minor tank leak/spill that can be easily stopped • A minor leak or spill to a containment system or portion of the INTEC that can be easily stopped

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(2) If the material released was to a secondary containment system, all released materials must be removed within 24 hours or in as timely a manner as is possible to prevent harm to human health and the environment	• A major tank leak from which total loss of contents could be realized. Upon notification of the emergency, the INL Fire Department is responsible for response and mitigation. Once the source of the leak/spill is identified and controlled, trained INTEC facility personnel will assess the extent of the spill/leak and will initiate corrective actions and cleanup activities. In the most extreme case of tank failure, the INTEC EAM will be notified and the contingency plan will be activated.
(c) Containment of visible releases to the environment. The owner/operator must immediately conduct a visual inspection of the release and, based upon that inspection: (1) Prevent further migration of the leak or spill to soils or surface water; and (2) Remove, and properly dispose of, any visible contamination of the soil or surface water.	Since all tanks and ancillary equipment for the CSSF are contained within permanent structures, release to soils or surface water is extremely unlikely. Migration of the leak or spill toward soils or surface water will be prevented as practicable, and any contaminated materials will be removed, characterized, and properly disposed of.
(d) Notifications, reports. (1) Any release to the environment, except as provided in paragraph (d)(2) of this section, must be reported to the Regional Administrator within 24 hours of its detection. If the release has been reported pursuant to 40 CFR Part 302, that report will satisfy this requirement. (2) A leak or spill of hazardous waste is exempted from the requirements of this paragraph if it is: (i) Less than or equal to a quantity of one (1) pound, and (ii) Immediately contained and cleaned up. (3) Within 30 days of detection of a release to the environment, a report containing the following information must be submitted to the Reg. Admin. (i) Likely route of migration; (ii) Characteristics of the surrounding soil (composition, geology, hydrogeology, climate); (iii) Results of any monitoring or sampling conducted in connection with the release (if available). If sampling or monitoring data relating to the release are not available within 30 days, these data must be submitted to the Reg. Admin. as soon as they become available. (iv) Proximity to down-gradient drinking water, surface water, and populated areas; and (v)	Any release from the tank system to the soil, groundwater, or surface water will be reported to the Director of the Idaho Department of Environmental Quality within 24 hours of detection, unless: • The release has already been reported pursuant to 40 CFR Part 302 • It is a spill of hazardous waste totaling less than or equal to one pound that was immediately contained and cleaned up. Within 30 days of detection of a release from the tank system to the soil, groundwater, or surface water, a report detailing the release will be submitted to the Director of the Idaho Department of Environmental Quality. This report will, at a minimum, contain the following: • The likely route of migration • Characteristics of the surrounding soil • The results of any monitoring or sampling conducted in connection with the release, if available • Proximity to down-gradient drinking water, surface water, and populated areas • A description of response actions taken or planned. In all cases the proper reports will be filed in accordance with Section G-8, the incident will be documented in the unit's operating record, and the PPE/equipment used in the response will be decontaminated or disposed and replaced.

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Description of response actions taken or planned.	
(e) Provision of secondary containment, repair, or closure.	
(1) Unless the owner/operator satisfies the requirements of paragraphs (e)(2) through (4) of this section, the tank system must be closed in accordance with Sec. 264.197. (2) If the cause of the release was a spill that has not damaged the integrity of the system, the owner/operator may return the system to service as soon as the released waste is removed and repairs, if necessary, are made. (3) If the cause of the release was a leak from the primary tank system into the secondary containment system, the system must be repaired prior to returning the tank system to service. (4) If the source of the release was a leak to the environment from a component of a tank system without secondary containment, the owner/operator must provide the component of the system from which the leak occurred with secondary containment that satisfies the requirements of Sec. 264.193 before it can be returned to service, unless the source of the leak is an aboveground portion of a tank system that can be inspected visually. If the source is an aboveground component that can be inspected visually, the component must be repaired and may be returned to service without secondary containment as long as the requirements of paragraph (f) of this section are satisfied. If a component is replaced to comply with the requirements of this subparagraph, that component must satisfy the requirements for new tank systems or components in Sections 264.192 and 264.193. Additionally, if a leak has occurred in any portion of a tank system component that is not readily accessible for visual inspection (e.g., the bottom of an inground or	A variance from secondary containment for the tank systems identified in this permit reapplication was previously requested. However, once a release has been contained and cleaned up, the affected unit(s) will be inspected and returned to service, provided that: • The cause of the release has been identified • The integrity of the tank and/or ancillary equipment has not been compromised • The source of the release has been repaired, as necessary • The affected area has been decontaminated • Spill response equipment has been replenished or decontaminated and returned to service.

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onground tank), the entire component must be provided with secondary containment in accordance with Sec. 264.193 prior to being returned to use. (f) Certification of major repairs. If the owner/operator has repaired a tank system in accordance with paragraph (e) of this section, and the repair has been extensive (e.g., installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel), the tank system must not be returned to service unless the owner/operator has obtained a certification by a qualified, registered, professional engineer in accordance with Sec. 270.11(d) that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. This certification must be submitted to the Regional Administrator within seven days after returning the tank system to use.	When a tank system repair has been extensive (such as repair of a ruptured primary containment), the tank system will not be returned to service until a certification by a qualified, registered, professional engineer in accordance with 40 CFR 270.11(d) has been obtained. The certification will reflect that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. This certification will be submitted to the DEQ within seven days after returning the tank system to use.
G-5 Emergency Equipment 40 CFR 264.52(e) 40 CFR 264.52(e) The plan must include a list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems (internal and external), and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	**G-5 Emergency Equipment** A variety of equipment is available at the INTEC for emergency response, containment, and cleanup operations. This includes equipment for spill control, fire control, personnel protection, monitoring and medical attention, communications, and alarms. This equipment is immediately available to emergency response personnel. A listing of available emergency equipment is shown in Table G-1. In the event a spill cannot be mitigated with the supplies kept at the permitted units, additional response supplies are available throughout the INTEC, and throughout the INL. Examples of safety and emergency equipment located at the CSSF include: • Portable fire extinguisher • Plant voice paging and evacuation alarm system • Internal voice paging system • Communication devices • Emergency lights and exit sign. Safety and emergency equipment provide adequate capabilities for trained personnel to respond to and control leaks, spills, and emergency situations until assistance arrives. The INL Fire Department has other emergency equipment including, but not limited to, self-contained breathing apparatus (SCBAs), stretchers, and first-aid kits.
G-6 Coordination Agreements 40 CFR 264.52(c) and 264.37	**G-6 Coordination Agreements**

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40 CFR 264.52(c) The plan must describe arrangements agreed to by local police departments, fire departments, hospitals, contractors, and State and local emergency response teams to coordinate emergency services pursuant to 264.37. 40 CFR 264.37Arrangements with local authorities. (a) The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations: (1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to and roads inside the facility, and possible evacuation routes. (2) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority; (3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and (4) Arrangements to familiarize local hospitals with the properties of hazardous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility. (b) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.	The INTEC EAM will ensure initial responders are dispatched to an emergency event originating at the INTEC. However, the level of response depends on the nature and extent of the incident. If warranted, additional INL resources are obtained, such as on-Site security, medical, and fire assistance, which are available on a 24-hour basis. Section G-1, General Information [40 CFR 264.53 (b)], contains the list of off-Site state, local and tribal agencies that are familiar with the contingency plan and may be called upon through agreements with the DOE-ID.

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G-7 Evacuation Plan 40 CFR 264.52(f) 40 CFR 264.52(f) The plan must include an evacuation plan for facility personnel where there is a possibility that an evacuation could be necessary. This plan must describe signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes (in cases where the primary routes could be blocked by releases of hazardous waste or fires).	**G-7 Evacuation Plan** The normal actions to protect nonemergency personnel are to minimize their exposure to radiation, airborne radioactivity, hazardous chemicals, and airborne hazardous chemicals, by seeking shelter, avoiding the accident area, or evacuating selected buildings or areas. In the event of an emergency that results in high radiation, hazardous chemical levels, or a continuing release to the environment, it may become necessary to evacuate the entire INTEC area. Building and Emergency Plan Maps depicting evacuation routes are located throughout the INTEC buildings. Upon exiting a building, personnel proceed to a designated staging area not affected by the emergency. The INTEC evacuation system alerts personnel of the need to evacuate the area. This system is on backup power; should power fail, it will automatically switch to a battery. Evacuation sirens are strategically located throughout the INTEC to provide coverage for all occupied areas. If the evacuation alarm is out of service or fails to operate, the evacuation will be communicated over the voice paging system, by word of mouth, or by security personnel using sirens or the voice amplifiers in their vehicles. Designated personnel known as area wardens are assigned responsibility for ensuring that personnel are evacuated from the area warden's assigned area or building or accounted for during evacuations. The following will allow for a safe, coordinated evacuation: • When an evacuation is announced, stop work • If possible and directed by the EAM, shut down designated operations that could contribute to further hazards, unless an "immediate" building evacuation is announced • Follow the voice-paging instruction or proceed to the closest building exit, unless blocked by hazards • Do not remain in the affected area, and assist injured personnel in leaving the area, if possible • Exit the facility through the security access points to the designated assembly area • Report to the designated assembly area • Be continually cognizant of wind direction (stay upwind) and emergency equipment • Do not reenter the fenced area of the INTEC, until the EAM authorizes reentry. During an evacuation, all personnel will remain in the designated assembly area, until given further instructions. The primary evacuation routes for the permitted units are depicted in the exhibits located at the end of this section. Alternative evacuation routes are through the nearest unobstructed emergency exit. **Evacuation Alarm** signal is an alternating tone-generated siren. **Fire Alarm** is announced over the INTEC voice paging system.

AT KEARNEY FORMAT SECTION REGULATORY REFERENCE/CITATION	COMPLIANCE METHODOLOGY
	Take-Cover Alarm is a steady tone-generated siren. This signal provides an emergency option to total INTEC evacuation**.**
G-8 Required Reports 40 CFR 264.56(j) and 40 CFR 264.56(i) 40 CFR 264.56(j) The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the CP. Within 15 days after the incident, he must submit a written report on the incident to the Regional Administrator. The report must include: (1) Name, address, and telephone number of the owner or operator; (2) Name, address, and telephone number of the facility; (3) Date, time, and type of incident (e.g., fire, explosion); (4) Name and quantity of material(s) involved; (5) The extent of injuries, if any; (6) An assessment of actual or potential hazards to human health or the environment, where this is applicable; and (7) Estimated quantity and disposition of recovered material that resulted from the incident. 40 CFR 264.56(i) The owner or operator must notify the Regional Administrator, and appropriate State and local authorities, that the facility is in compliance with paragraph (h) of this section before operations are resumed in the affected area(s) of the facility.	**G-8 Required Reports** Any fire, explosion, or unplanned release of hazardous or mixed waste or hazardous constituent requiring activation of the contingency plan will be reported by the Permittee in writing within 15 days to the Director of the Department of Environmental Quality. Such reports will include, as a minimum, the following: • Name, address, and telephone number of the facility owner/operator • Name, address, and telephone number of the facility • Date, time, and type of incident (such as fire, explosion, release) • Name and quantity of the material(s) involved • Extent of any injuries to personnel at the facility • An assessment of any actual or potential hazards to human health or the environment, as applicable • Estimated quantity and disposition of material recovered from the incident (includes fire fighting materials, such as water, foam, adsorbents/absorbents, etc.). In accordance with IDAPA 58.01.05.008 [40 CFR 264.56(I)], the Permittee will notify the Director of the Department of Environmental Quality that: • The permitted units are in compliance with requirements for the cleanup of areas affected by the emergency and that the emergency equipment used in the emergency response has been cleaned or replaced and is fit for the intended use, before the resumption of waste management activities • The permitted units have experienced a fire, explosion, spill, or release of hazardous waste or hazardous waste constituents or an emergency resulting in a release of a hazardous substance included in 40 CFR 302.4 that could threaten human health or the environment outside the INTEC • The contingency plan will be activated, and the EAM will ensure that local authorities are notified in writing.

Table G-1. Emergency response equipment available at the CSSF.

Emergency Equipment	Location	Capabilities
Fire control		
Portable fire extinguisher (ABC or CO_2)	Inside the personnel door of each CSSF, or near the door on the outside	Use during incipient stage of fire (10–60-sec discharge time)
Emergency Communication/Alarm System		
Manual fire alarm boxes	Located at each CSSF	Summon INL Fire Department
Communication Devices	Located at each CSSF	On-Site / Off-Site communications
Two-way radios	Used by field personnel	On-Site communications
Sitewide evacuation alarm	Alarm may be sounded throughout the INTEC	Provides immediate notice of evacuation
Internal voice paging system	Located throughout the INTEC	Provides general and emergency information

Note: Fire extinguishers are not currently present at CSSF 7 as it contains no waste.

Exhibit G-1. Evacuation Routes for CSSFs 1–7.

CPP 639

Building Emergency Plan

Emergency Response .... 777 or 526-7777

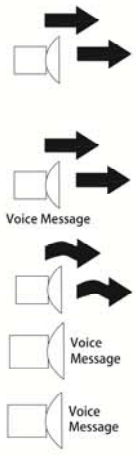
Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



Steady Siren — **Take Shelter**

Seek shelter in the nearest building.
All doors and windows are to be shut.
Do not eat, drink, chew, or smoke.
Turn ventilation off as directed by management.
Prepare for evacuation.

Steady Siren with Voice — **Security Take Cover**

Seek shelter in the nearest building.
Do not leave work area.
Stay away from windows and doors.
Listen for instructions over the emergency warning system.

Alternating Siren — **Evacuate**

Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

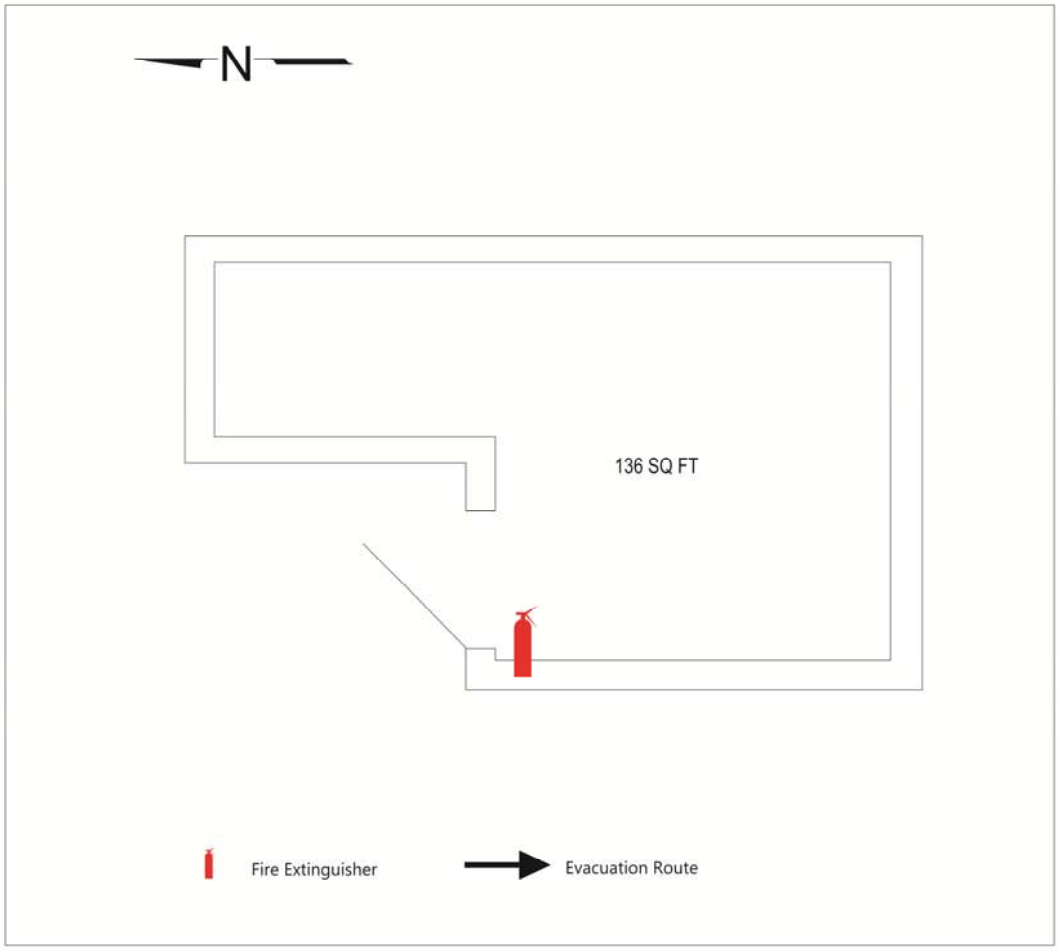
Evacuate immediate area and go to the staging area (see inset).

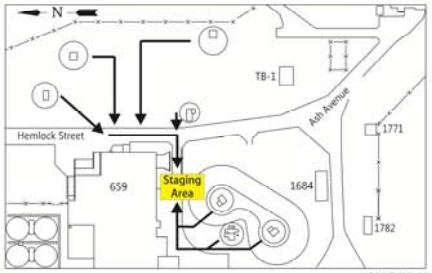
Emergency Warning System — **Other**

Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.





G08-2152-06
2/3/16

CPP 646

Building Emergency Plan

Emergency Response .... 777 or 526-7777

Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



Steady Siren — **Take Shelter**

Seek shelter in the nearest building.
All doors and windows are to be shut.
Do not eat, drink, chew, or smoke.
Turn ventilation off as directed by management.
Prepare for evacuation.

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Do not leave work area.
Stay away from windows and doors.
Listen for instructions over the emergency warning system.

Alternating Siren — **Evacuate**

Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

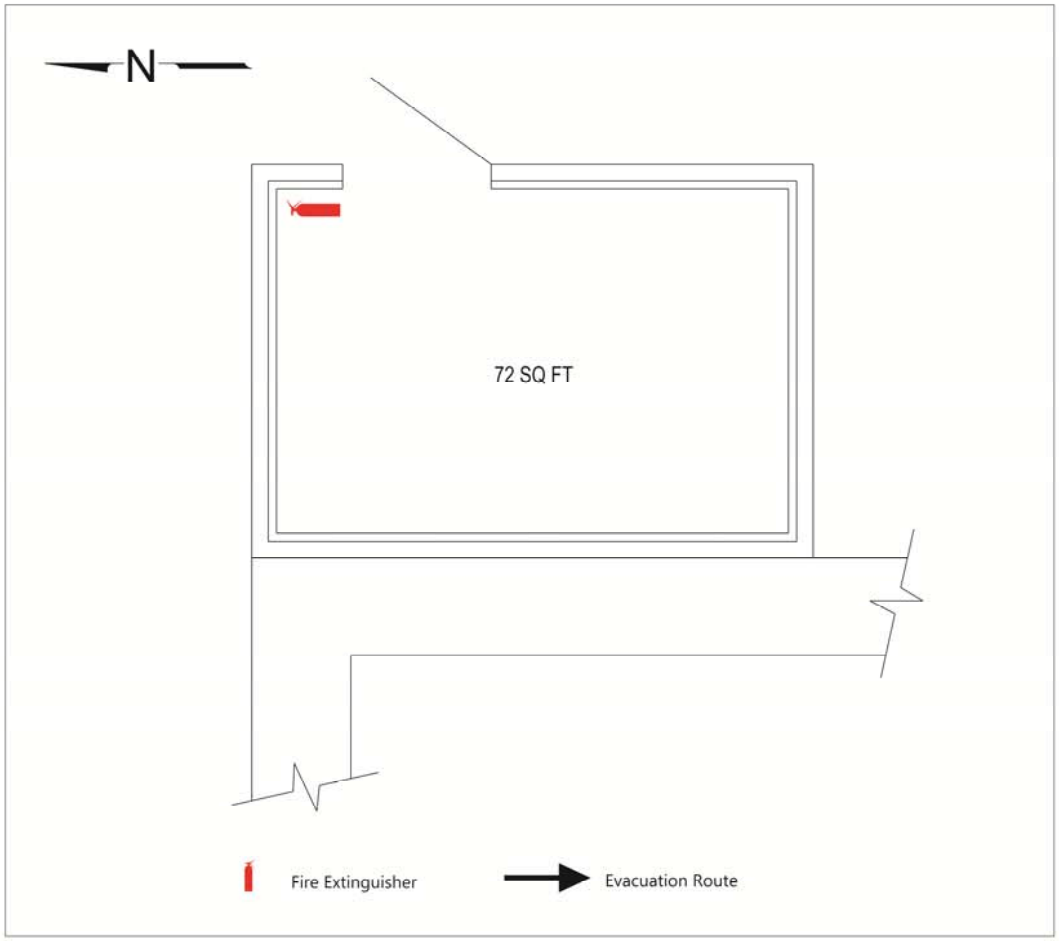
Evacuate immediate area and go to the staging area (see inset).

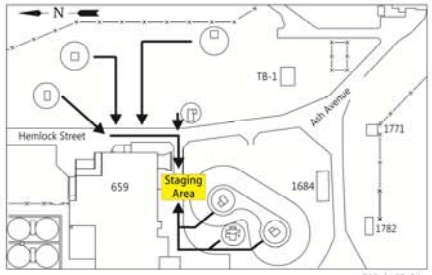
Emergency Warning System — **Other**

Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.





G08-2152-04
2/3/16

CPP 647

Building Emergency Plan

Emergency Response .... 777 or 526-7777

Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



Steady Siren — **Take Shelter**

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Do not eat, drink, chew, or smoke.
Turn ventilation off as directed by management.
Prepare for evacuation.

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Do not leave work area.
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Listen for instructions over the emergency warning system.

Alternating Siren — **Evacuate**

Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

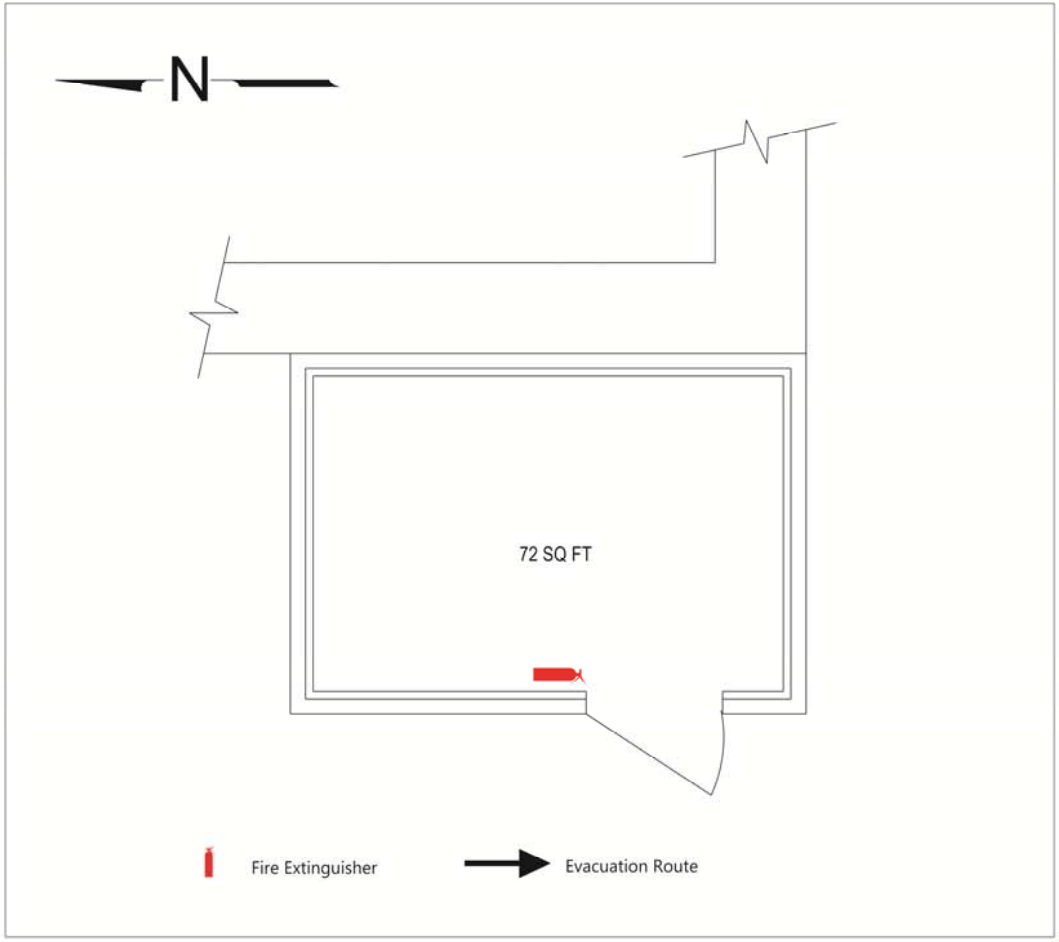
Evacuate immediate area and go to the staging area (see inset).

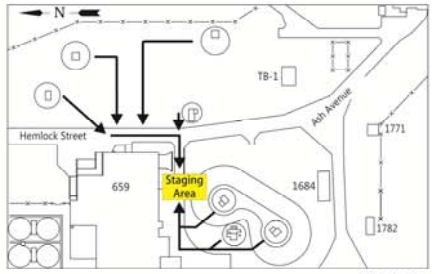
Emergency Warning System — **Other**

Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.





G08-2152-05
2/3/16

CPP 760/658

Building Emergency Plan

Emergency Response .... 777 or 526-7777

Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



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Seek shelter in the nearest building.
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Turn ventilation off as directed by management.
Prepare for evacuation.

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Listen for instructions over the emergency warning system.

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Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

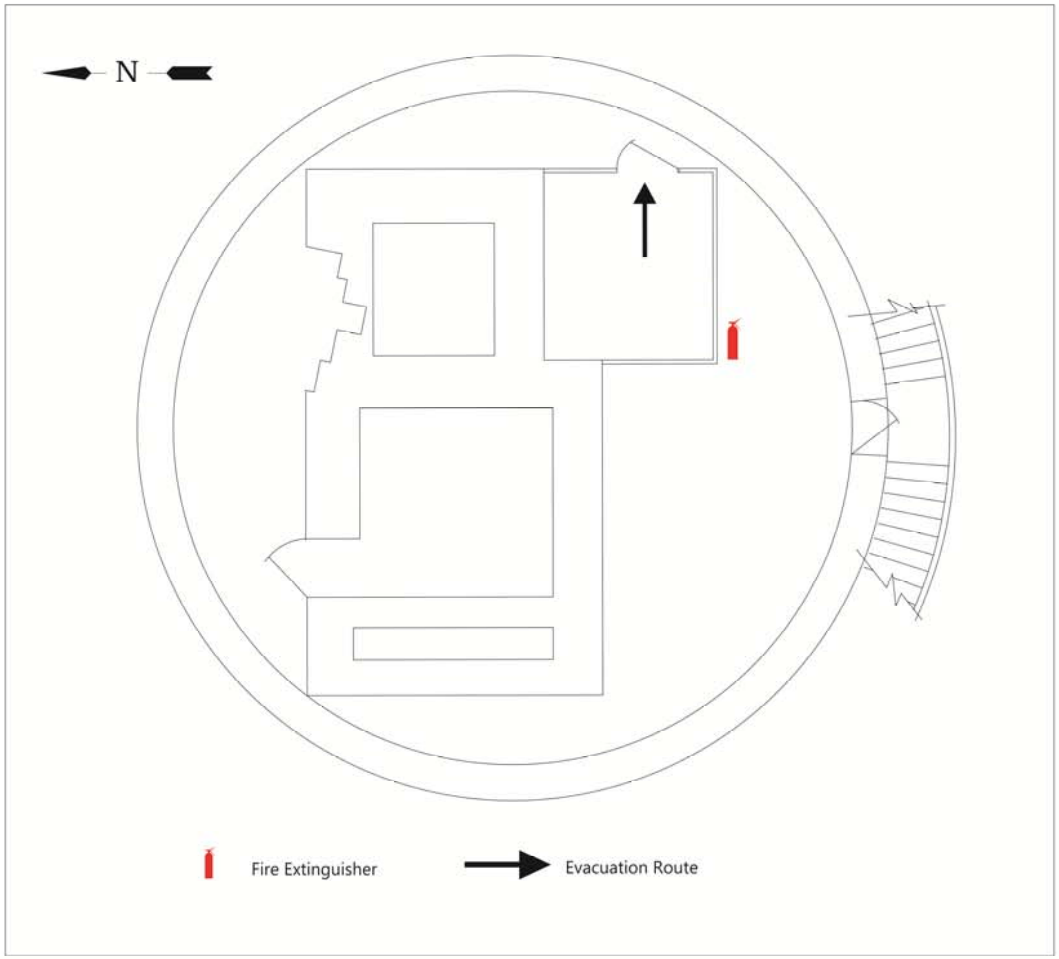
Evacuate immediate area and go to the staging area (see inset).

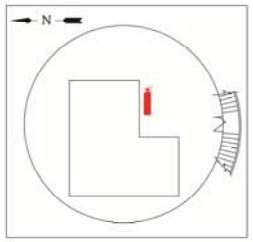
Emergency Warning System — **Other**

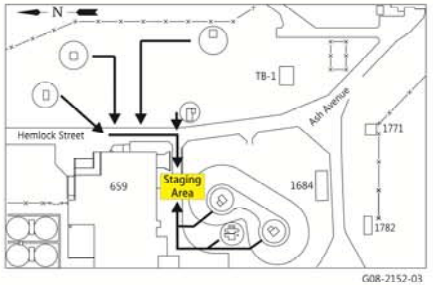
Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.







G08-2152-03
2/3/16

CPP 765/671

Building Emergency Plan

Emergency Response .... 777 or 526-7777

Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



Steady Siren — **Take Shelter**

Seek shelter in the nearest building.
All doors and windows are to be shut.
Do not eat, drink, chew, or smoke.
Turn ventilation off as directed by management.
Prepare for evacuation.

Steady Siren with Voice — **Security Take Cover**

Seek shelter in the nearest building.
Do not leave work area.
Stay away from windows and doors.
Listen for instructions over the emergency warning system.

Alternating Siren — **Evacuate**

Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

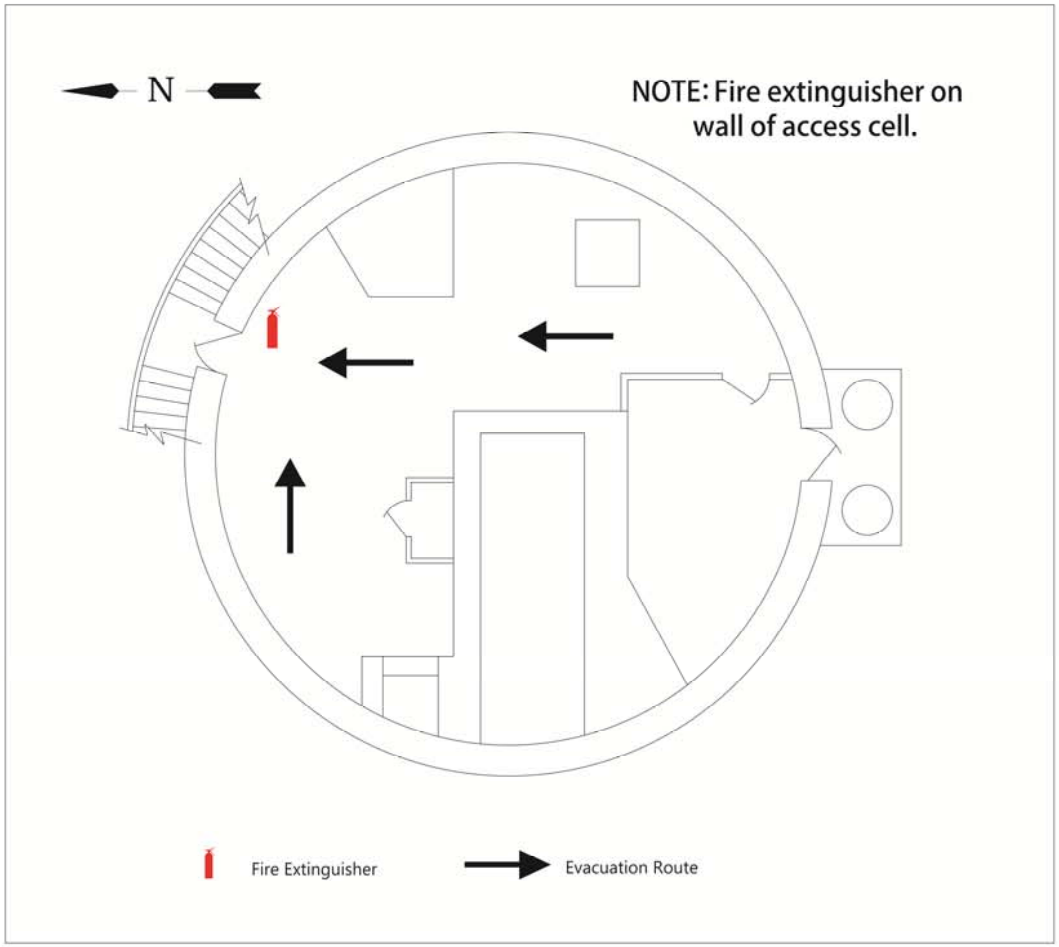
Evacuate immediate area and go to the staging area (see inset).

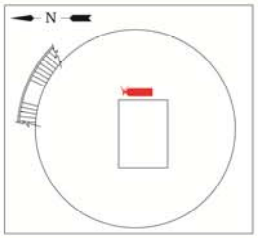
Emergency Warning System — **Other**

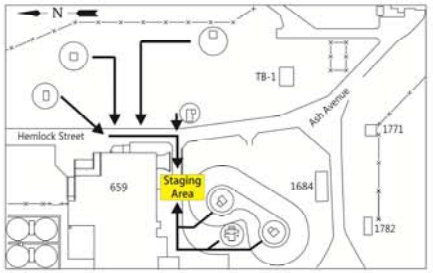
Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.







G08-2152-02
2/3/16

CPP 791/673

Building Emergency Plan

Emergency Response .... 777 or 526-7777

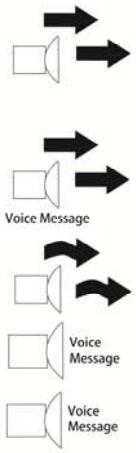
Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



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Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

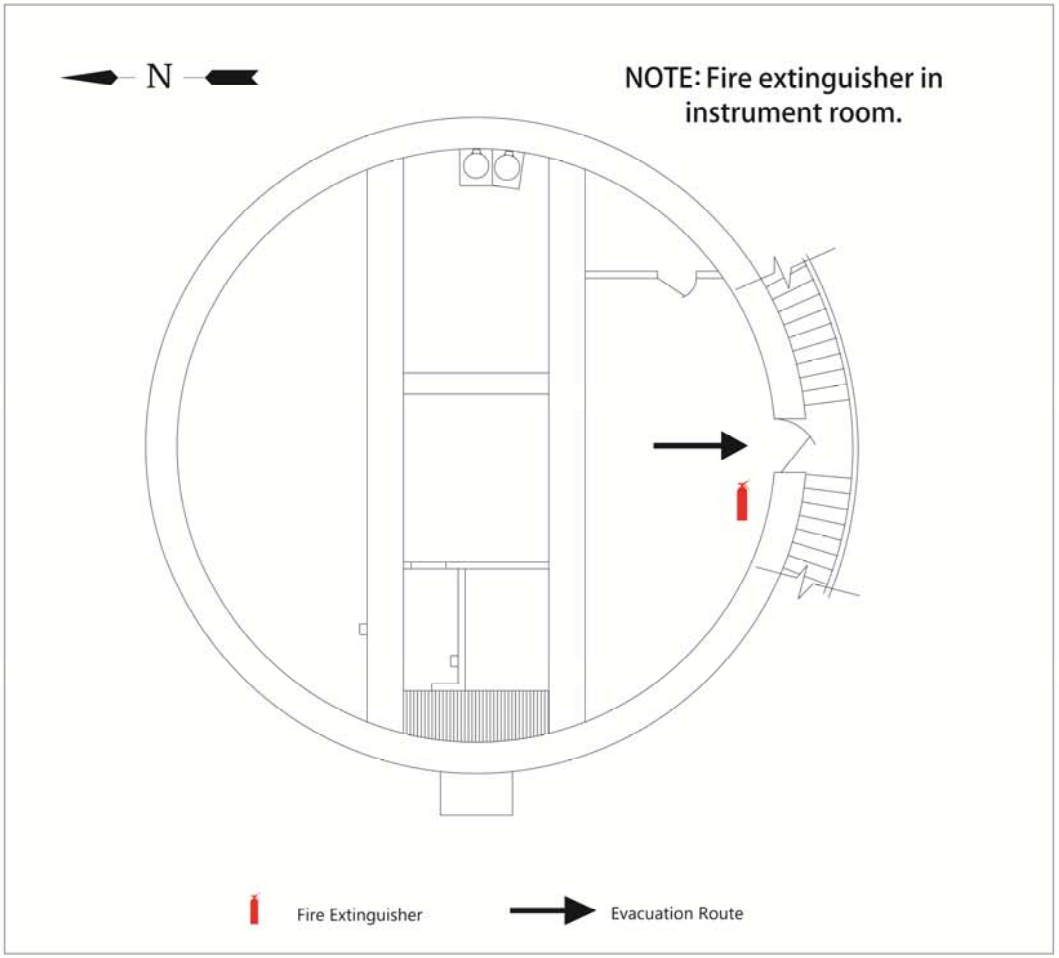
Evacuate immediate area and go to the staging area (see inset).

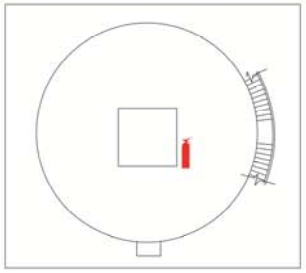
Emergency Warning System — **Other**

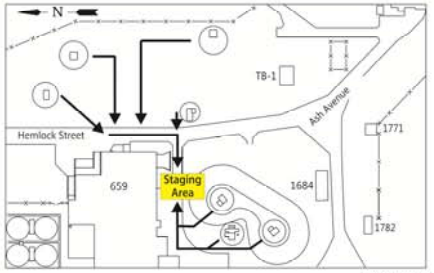
Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.







G08-2152-07
2/3/16

CPP 795/1615

Building Emergency Plan

Emergency Response .... 777 or 526-7777

Person discovering an event should:

- Immediately telephone 777 or 526-7777 or activate nearest appropriate alarm
- Then call Plant Shift Supervisor at 526-3100 or cell 521-0883

Event Reporting Information

Type of event
Location
Magnitude
Cause needed
Affected personnel

Alarms and Responses:



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Turn ventilation off as directed by management.
Prepare for evacuation.

Steady Siren with Voice — **Security Take Cover**

Seek shelter in the nearest building.
Do not leave work area.
Stay away from windows and doors.
Listen for instructions over the emergency warning system.

Alternating Siren — **Evacuate**

Proceed immediately to the designated assembly area as indicated by the evacuation route (see inset).
Report to your personnel warden.

Fire Alarm — **Fire**

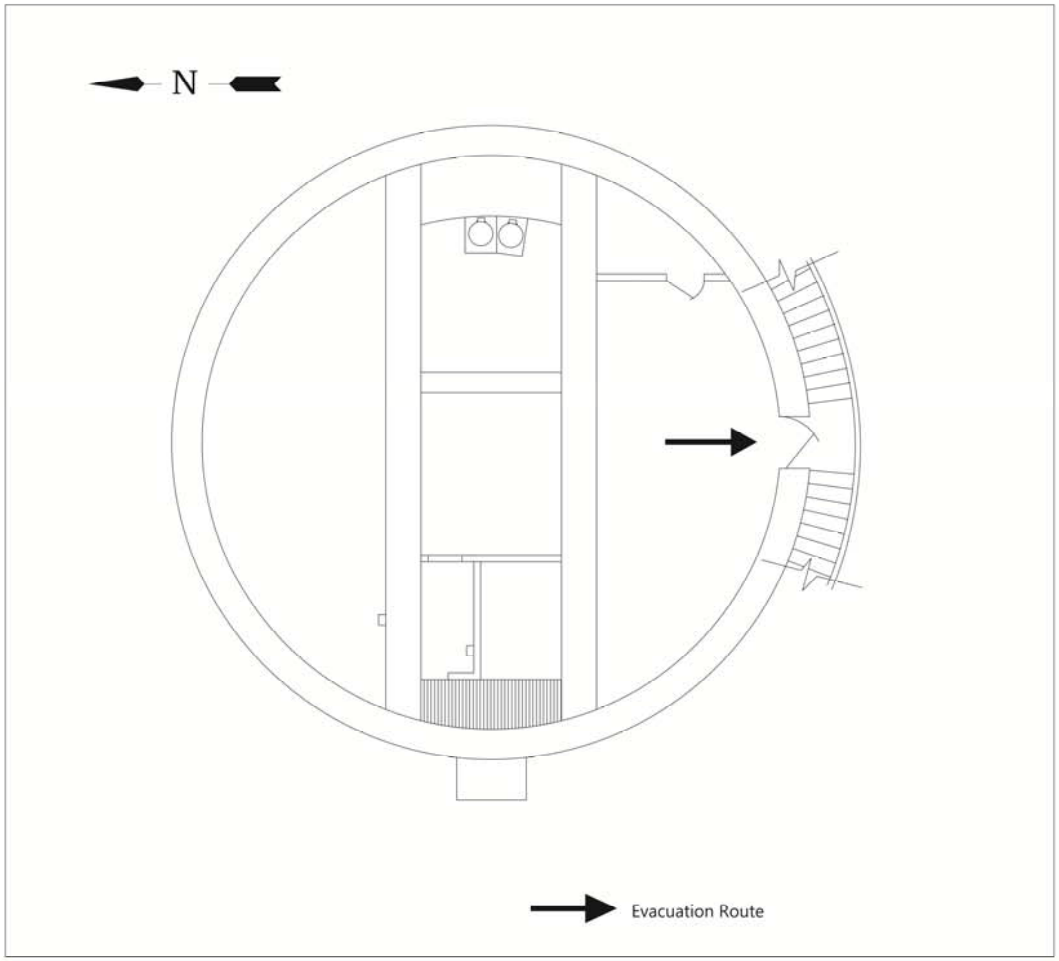
Evacuate immediate area and go to the staging area (see inset).

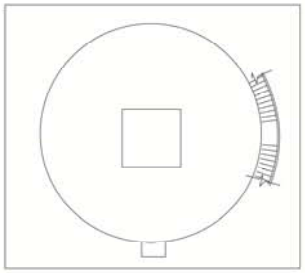
Emergency Warning System — **Other**

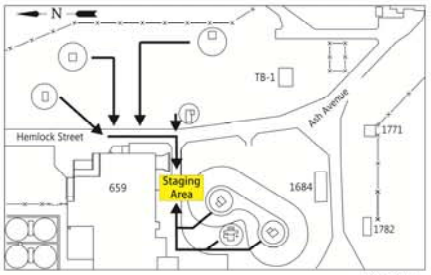
Follow directions of message.

Hazards

General hazards associated with storage and handling of nuclear fuel.







G08-2152-01
2/3/16

Attachment 8
Section I Closure

RCRA PART B PERMIT

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 8 - Section I
Closure and Post Closure Requirements

Revision Date: December 17, 2025

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TABLE

1-1. Potential Unit Closure Debris Treatment Technologies 5

I. CLOSURE AND POSTCLOSURE REQUIREMENTS

This closure plan specifies Idaho Nuclear Technology and Engineering Center (INTEC) performance standards and procedures for the waste management units addressed in this permit reapplication. The activities and closure performance standards described in this plan apply only to Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA)-regulated wastes. Prior to initiation of closure, all hazardous waste will be removed from the units and disposed of according to applicable laws and regulation.

The closure performance standards for decontaminating equipment and components correspond to applicable regulatory guidelines. Closure activities will address contaminated process equipment and building components to be salvaged as scrap metal or other recyclable material; contaminated process equipment and building components to be reused for non-waste management purposes; contaminated process equipment and building components to be disposed of as hazardous waste debris; and residues/wastes resulting from decontamination activities.

I-1. CLOSURE AND POSTCLOSURE REQUIREMENTS [IDAPA 58.01.05.008 and 58.01.05.012; 40 CFR 270.14(b)(13), 264.111, and 264.112(a)(1) and (2)]

This closure plan describes the procedures to be used to remove remaining waste residues and to decontaminate process equipment and building components to achieve closure performance standards specified in the Idaho Administrative Procedures Act (IDAPA) 58.01.05.008 [40 Code of Federal Regulation (CFR) 264.111]. The units addressed in this permit reapplication will be operated and closed to prevent releases to the environment. Postclosure escape of hazardous waste constituents to the ground, surface water, or atmosphere will be nonexistent. Therefore, continued maintenance activities after closure is completed will not be required. This closure plan satisfies the requirements of IDAPA 58.01.05.008 (40 CFR 264.111 through 264.115 and applicable parts in 40 CFR 264.197).

I-1a. Closure Performance Standards (IDAPA 58.01.05.008; 40 CFR 264.111)

The closure process is designed to:

- Minimize the need for further maintenance
- Control, minimize or eliminate to the extent necessary to protect human health and the environment, postclosure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere
- Complies with the closure requirements of applicable portions of 40 CFR 264.

The closure performance standards for the units are in accordance with applicable portions of IDAPA 58.01.05.006 through 58.01.05.012 (40 CFR 262 through 270). HWMA/RCRA closure activities are considered precursor efforts to the ultimate facility deactivation and decommissioning (D&D). Technical approaches to this ultimate facility D&D will have practical bearing on the appropriate approach to HWMA/RCRA-regulated closure. At this time, the Department of Energy Idaho Operations Office (DOE-ID) approach to facility D&D for the Calcined Solids Storage Facility (CSSF) has not been determined. Therefore, this plan presents assumptions based on past and current HWMA/RCRA-regulated closure and D&D activities at the INTEC. This integration of HWMA/RCRA closure activities with subsequent D&D activities is reflected in Number 3 below as it relates to contaminated process equipment and building components that would remain in place and undergo subsequent facility D&D. Performance standards, probable scenarios affecting process equipment, building components, and decontamination residuals are indicated below:

1. Contaminated process equipment and building components salvaged as scrap metal/materials will be decontaminated as described in Section I-1d. Process equipment and building materials will be decontaminated in a manner and degree as specified by the recycle scrap metal/material vendor in conformance with their recyclable material acceptance criteria. To attain the closure performance standard, the subject process equipment and building components may be subjected to decontamination techniques such as sweeping, brushing, scraping, wiping, or rinsing. The selected means of decontamination will be material-specific and dependent on the effectiveness in attaining the contracted recyclable materials vendor acceptance criteria, minimization of the potential spread of contamination, and minimization of decontamination wastes. All decontamination media and other

residuals generated from this closure activity will be managed as identified in Section I-1d of this permit reapplication.

2. The performance standard for reusable process equipment and building components will be a degree of decontamination consistent with the intended "postclosure" use of the process equipment or building components as determined by INL-accepted industrial hygiene and health physics protocols and guidelines. The need to decontaminate room, vault or equipment surfaces will be determined initially by reviewing the operating record for evidence that hazardous waste or hazardous constituents came into contact with the structure or equipment in question. In addition to the operational record review, visual observation will be completed by using visual aids such as mirrors, remote cameras, etc.

3. Other than internal surfaces of tank systems and ancillary equipment, the performance standard for contaminated process equipment and building components that would remain in place and undergo subsequent facility D&D will be a level of chemical or physical decontamination required to render the equipment or structural surfaces "clean," analogous to that specified and identified under IDAPA 58.01.05.011 (40 CFR 268.45). The degree of decontamination will be based on how extensively the equipment or structure was used in waste treatment operations, and the likelihood that it came into direct contact with the hazardous waste. An assessment of the facility operating record and spill records will be conducted to determine the extent of potential waste contamination. Equipment and structures that have documented releases, waste-related stains, or known contact with waste materials will be decontaminated, using an appropriate decontamination solution/method and/or be decontaminated using a method analogous to an alternative treatment technology identified in IDAPA 58.01.05.011 (40 CFR 268.45).

In the event that this primary performance standard is not achievable upon the initial decontamination campaign, the appropriateness of the decontamination media will be verified and a second decontamination effort will be undertaken, potentially with different and/or more aggressive chemical agents or physical removal methods. If upon completion of the second decontamination campaign, apparent waste-related stains remain greater than 5% of the equipment or structural surface area, an equipment/building surface sampling regimen will be considered. Design and implementation of this sampling regimen and corresponding data quality objectives and performance standard will be presented to the Idaho Department of Environmental Quality (DEQ) as an amendment to the closure plan. Depending on the timeframes involved, development, DEQ approval and implementation of this sampling regimen would likely require an extension of the timeframe to complete closure

pursuant to IDAPA 58.01.05.008, 40 CFR 264.113(a) and 264.113(b). It is anticipated that results from such a sampling effort would be utilized to assess the worker, nonresidential scenario risk posed by residual hazardous constituent contamination, such that the concentrations of contaminants remaining in the units would not pose a risk to human health and the environment.

4. The performance standard for contaminated process equipment and building components to be managed as hazardous debris will be the alternative treatment standards for hazardous waste debris in IDAPA 58.01.05.011 (40 CFR 268.45), or the equipment/components will be managed as hazardous waste, per IDAPA 58.01.05.006 through .012 (40 CFR 262 through 270). Contaminated process equipment and building components will be managed as hazardous waste debris, either at an INL or off-Site treatment, storage, or disposal (TSD) unit. This may entail decontamination until the standard for attaining a "clean debris surface" is achieved, as verified by visual inspection of the contaminated surface. Clean debris surface means that the surface, when viewed without magnification, shall be free of visible contaminated soil and hazardous waste except that residual staining from soil and waste, consisting of light shadows, slight streaks, or minor discoloration. Soil and waste in cracks, crevices, and pits may be present, provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of surface area. Table I-1 summarizes potential physical and chemical extractive treatment technologies to be employed and the corresponding type of process equipment or building components. Following decontamination and/or equipment removal, the area will be swept clean of debris. Materials will be removed and containerized. All collected decontamination media and collected dirt and debris will be sampled, analyzed, and managed accordingly. An alternative to the described closure activities that may be exercised at the time of closure is dismantling, packaging, manifesting as hazardous waste, and transport of contaminated equipment to be disposed of to an interim status/permitted TSD unit.

5. Decontamination media, rinsates, residues, and used Personal Protective Equipment (PPE) generated from the decontamination of recyclable scrap metal/material, reusable equipment, and hazardous waste debris will be characterized per the Waste Analysis Plan (WAP) of this permit reapplication. As detailed in Section C, characterization will be determined by acceptable process knowledge or sampling and analysis. Management of mixed waste streams will, as necessary, be addressed in the INL Site Treatment Plan and may include incineration, stabilization, or other acceptable means of treatment, as necessary. All characterization activities performed in conjunction with this closure action will be in accordance with the current WAP for this permit reapplication.

Table I-1. Potential Unit Closure Debris Treatment Technologies.

Component or Subsystem	Extractive or Immobilization Treatment Technology[1]
Ancillary equipment and surfaces	High-pressure steam and water sprays,[2] abrasive blasting, CO_2 blasting
Structural components (metal wall panels, floor surfaces, structural beams, ceiling materials, etc.)	CO_2 blasting, abrasive blasting, high-pressure steam and water washing, spraying,[2] spalling
Miscellaneous metal ducting	CO_2 blasting, abrasive blasting, high-pressure steam and water washing, spraying[2]
Tank Storage Units and Affected Sumps	
Tanks	Not classified as debris, see Section I-1d(2)
Affected ancillary equipment and surfaces, secondary containment devices, including sump surfaces	High-pressure steam and water sprays,[2] abrasive blasting, CO_2 blasting

1. From IDAPA 58.01.05.011 (40 CFR 268.45, Table 1).
2. Would require an Equivalent Technology Approval per IDAPA 58.01.05.011 [40 CFR 268.42(b)].

I-1b. Partial Closure Activities [IDAPA 58.01.05.008; 40 CFR 264.112(a)(1)]

The Bin Sets occupy 7 separate vaults. Each Bin Set will be closed separately. This would constitute a partial closure for this permit reapplication. Therefore, partial closure activities would be preceded by notification of the DEQ and undertaking an amendment to the closure plan pursuant to IDAPA 58.01.05.008, 40 CFR 264.113(a) and 264.113(b).

I-1c. Maximum Waste Inventory [IDAPA 58.01.05.008; 40 CFR 264.112(b)(3)]

This Part B permit reapplication includes the Part A hazardous waste permit for units in this permit reapplication. The Part A permit application indicates the maximum potential waste inventory for units. In addition, the operating record for each unit will identify the occurrence of waste spills, if any, over the operating life, and the measures taken to mitigate the spill.

I-1d. Inventory Removal and Disposal or Decontamination of Equipment, Structures, and Soils (IDAPA 58.01.05.008; 40 CFR 264.111, 264.112, and 264.114)

Selection of specific process equipment and building components, and the degree of decontamination efforts, will be based on whether the equipment and structures have come into direct contact with waste, whether or not there is visual evidence of waste-related staining or streaking, the nature of constituents or contaminants present, and whether the equipment and structures will be managed for recycle, reuse, or disposal as hazardous debris. Due to the design and integrity of the bins at closure,

releases to the environment are unlikely. As a result, disposal of contaminated soils pursuant to this permit reapplication is not anticipated. Section I-1a., Closure Performance Standards (IDAPA 58.01.05.008; 40 CFR 264.111), addresses the protocols for achieving the closure performance standards or management processes for the following groupings of process equipment, contaminated structures and residues:

- Contaminated process equipment and building components to be salvaged as scrap metal/materials
- Contaminated reusable process equipment and building components
- Contaminated process equipment and building components that would remain in place and undergo subsequent facility deactivation and decommissioning
- Contaminated process equipment and building components to be managed as hazardous debris
- Decontamination media, rinsate, residues, and used PPE.

The selected means of decontamination will depend on effectiveness in attaining the closure performance standard, minimization of the potential spread of contamination, and minimizing the generation of decontamination waste. Room or area surfaces contaminated during decontamination of equipment will be closed in the same fashion. If used, fluids from equipment decontamination using an ancillary pumping system will be collected in containers and stored within the work area. Spill booms, spill control pillows, swabs, or other absorbent material(s) may also be used to contain the residual fluids and facilitate removal.

Process Equipment and Building Components – Selection of Potential Debris Treatment Technologies Employed

As indicated in Section I-1a, Closure Performance Standard, dismantled contaminated process equipment and building components to be disposed of as solid waste will be managed in accordance with the treatment standards for hazardous debris in IDAPA 58.01.05.011 [40 CFR 268.45(a)]. In general, hazardous debris must be treated for each "contaminant subject to treatment," as defined in IDAPA 58.01.05.011 [40 CFR 268.45(a)], using the technology or technologies specified in IDAPA 58.01.05.011 (40 CFR 268.45, Table 1). The proposed debris treatment and waste storage activities will involve metal-bearing characteristic wastes. Given this fact, debris treatment conducted as part of facility closure will necessarily consider TCLP constituents subject to treatment, and the corresponding treatment standards indicated under IDAPA 58.01.05.011 (40 CFR 268.45). While not all-inclusive, Table I-1 indicates the process

equipment, building component or subsystem, and the probable corresponding physical and chemical extractive debris treatment technology description. Any contaminant restrictions relative to application of technologies other than the best demonstrated available technology would be presented to the Idaho DEQ Director for approval, prior to implementation.

Alternate Treatment Technology Selection Process

Prior to implementation of a given alternative treatment technology specified in Table I-1 or otherwise, a comprehensive engineering evaluation will be made of the given form of debris (such as metal versus plastic), the known hazardous constituents, radiological considerations, industrial hygiene concerns, and any other factors that may affect technology selection. If, based on this evaluation, a suitable alternative treatment technology is not clearly indicated, a treatability study of one or more technologies may be undertaken on that class of debris waste. Based on the initial engineering evaluation or the successful identification of a technology via treatability studies, an alternative treatment technology will be selected for implementation. In all cases, the performance standard for any technology implemented (specified on Table I-1) will be the clean debris surface standard under IDAPA 58.01.05.011 (40 CFR 268.45).

Vault Surfaces

Contaminated vault surfaces as indicated by an assessment will be cleaned of dirt and other residuals, as necessary. Materials will be removed and containerized, followed by decontamination to attain an appearance analogous to the "clean debris surface."

Transfer Areas and General non-Waste Handling Equipment

Equipment and structures that have no documented releases, visible signs of release, or known contact with waste will be decontaminated using customary radiological decontamination practices or standard housekeeping procedures. At a minimum, equipment and structures will be wiped down or mopped with a suitable decontamination medium. Portions of the floor with no known contact with hazardous waste will be mopped or wiped down. Residues generated by this general cleaning or decontamination will undergo a hazardous waste determination in accordance with the current WAP for this permit reapplication. Environmental Protection Agency (EPA) SW-846 or equivalent methodologies will be used, matching contaminant of concern with appropriate sample type, quantity, and analysis.

Hazardous Residue Management

Process equipment and building components that undergo decontamination on-Site will be decontaminated in appropriate areas within the INTEC as necessary, or at other approved INL facilities available at the time of closure. If used, fluid resulting from decontamination activities will be contained within the work area and collected in containers using an ancillary pumping or other system as needed. Spill booms, spill control pillows, swabs, or other absorbent materials may be used to contain the residual fluids and facilitate removal. Following decontamination and/or equipment removal, the area will be swept clean of dirt and residuals. Materials will be collected and containerized. Recovered decontamination media and collected dirt and residuals will be characterized in accordance with Section C of this permit reapplication and managed according to the results of the analysis. When sampling and analysis is required, EPA SW-846 or equivalent methodologies will be used, matching contaminant of concern with appropriate sample type, quantity, and analyses. An alternative to the described closure activities that may be exercised at the time of closure is dismantling, packaging, and transport of contaminated equipment to be disposed of at an on-Site or off-Site RCRA interim status or permitted facility for required treatment and subsequent disposal.

All of the indicated waste, residue, and decontamination materials and/or rinsates will be containerized and sampled as described and stored in INL HWMA/RCRA-compliant facilities as "Unknown-Pending Sampling and Analysis," until analytical results indicating the hazardous classification, if any, of the waste is received. In addition, all disposable PPE, other disposable equipment, and all other wastes generated during closure activities will be containerized and characterized in accordance with the current WAP. When sampling and analysis is required, EPA SW-846 or equivalent methodologies will be used, matching contaminant of concern with appropriate sample type, quantity, and analysis. Before being moved from any areas undergoing decontamination, reusable PPE will be decontaminated by removing residual materials from booties, gloves, anti-C's, and spraying, washing, and scrubbing all outside protective clothing surfaces. Treatment and disposal of these waste streams will be addressed in the INL Site Treatment Plan and may include incineration, stabilization, or other acceptable methods of treatment, as necessary.

I-1d(2) Closure of Tank Systems [IDAPA 58.01.05.008; 40 CFR 264.197]

Tanks addressed by this closure plan located in CSSFs 1–7. The tank systems will be considered "clean closed" when the following methods are completed to meet the closure performance standards:

- Wastes are removed from the tanks, pipelines, ancillary equipment, and surfaces of the system.

- If removed from the facility and managed as (1) salvageable scrap metal/materials, or (2) reused as process equipment, the performance standard is that specified in Section I-1a above.

- If left physically intact, in place and not managed as hazardous waste debris, the tanks, piping, ancillary equipment, and building interiors associated with these tank systems are decontaminated in a manner to achieve the performance standard. Probable decontamination solutions may include one or more acidic or alkaline decontamination solutions, or appropriate combinations of the two.

In verifying the effectiveness of decontamination activities, the contractor will make use of the following measurements and determinations:

(1) **Levels of removable hazardous chemical constituents on swipe samples taken from decontaminated surfaces**. Swipes will be moistened with mildly acidic (pH 3 to 5) solution, appropriate for removing waste constituents adhering to the tank system surfaces. Closure of the tank systems will be considered successful when concentration of hazardous constituents smear samples do not exceed two times the method detection limit (as defined in the appropriate procedure of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, current edition).

(2) **Levels of hazardous chemical constituents and hazardous characteristics in spent decontamination solutions**. Closure of the tank systems will be considered successful when the concentration of hazardous constituents in spent decontamination solutions do not exceed the risk-based action levels. Spent decontamination solutions may be sampled downstream at a suitable storage tank.

(3) **Radiological surveys of tank exterior walls**. Radiological surveys will be taken of tank exterior walls to verify removal of the solid waste fraction, if any.

(4) **Boroscope or other visual determination methods**. Boroscope or other visual determination methods will be used for verifying removal of the solid waste fraction, if any.

I-1e. Other Closure Activities [IDAPA 58.01.05.008; 40 CFR 264.112(b)(5)]

No other activities such as groundwater monitoring, leachate collection, or run-on/run-off control are appropriate or planned for these units.

I-1f. Schedule for Closure [IDAPA 58.01.05.008; 40 CFR 264.112(b)(6)]

The Director of the DEQ will be notified in writing at least 45 days prior to the date that closure operations are planned to begin. The projected schedule for closure of these units is generalized as follows:

Activity	Day Completed
Initiate closure activities	Day 0
Complete equipment decontamination	Day 100
Complete surface decontamination	Day 140
Decontaminate tools, complete waste assessments, remove wastes	Day 160
Complete all closure activities	Day 180
Submit closure certification to the State of Idaho	60 days after completion of closure

I-1g. Extension for Closure Time [IDAPA 58.01.05.008; 40 CFR 264.113(a) and 264.113(b)]

Closure of these units is scheduled for completion within the prescribed 180-day period. No variance is requested at this time. If it is later determined that an extension for the closure time is necessary a permit modification request will be submitted to the Director of DEQ per IDAPA 58.01.05.012 (40 CFR 270.42).

I-1h. Certification of Closure [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.11(d) and 264.115]

A registered professional engineer (PE), the operator, and DOE-ID will provide to the DEQ within 60 days of the completion of closure, a certification of closure for each unit in accordance with IDAPA 58.01.05.008 (40 CFR 264.115). The certification will state that each unit was clean closed in accordance with the approved closure plan. Final closure activities will be considered complete upon submittal of supporting documentation to the PE's certification and the certification of closure, and then written acceptance issued by the DEQ. These units will not be closed as a land disposal facility; therefore, a "Notice in Deed" and survey plat are not required.

I-2. Postclosure Plan [IDAPA 58.01.05.012; 40 CFR 264.197(b) and 270.14(b)(13)]

Since all hazardous or mixed wastes will be removed prior to closure and any residual hazardous chemical contamination will be removed during closure, a postclosure plan is not required. Also, there have been no releases to the environment that would require a contingent landfill closure plan.

I-3. Postclosure Notices [IDAPA 58.01.05.012; 40 CFR 270.14(b)(14)]

Since all hazardous and mixed wastes will be removed prior to closure and any residual hazardous chemical contamination will be removed during closure, postclosure notices are not required.

I-9. State Mechanisms

I-9a. Use of State Required Financial Mechanisms [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.14(b)(18) and 264.149]

I-9b. State Assumption of Responsibility [IDAPA 58.01.05.012 and 58.01.05.008; 40 CFR 270.14(b)(18) and 264.150]

The INL is owned by the U.S. Department of Energy; therefore, the facility is exempt from providing a closure cost estimate, financial assurance mechanism, meeting liability requirements, or compliance with state mechanisms under IDAPA 58.01.05.012 and 40 CFR 270.14(b)(18) and 264.149 and 264.150.

Attachment 9
Permit Revision Log

RCRA PERMIT

FOR THE

IDAHO NATIONAL LABORATORY

Volume 22
Idaho Nuclear Technology and Engineering Center

Calcined Solids Storage Facility

Attachment 9

Permit Revision Log

Revision Date: December 17, 2025

PERMIT REVISION LOG

SUBMITTED	APPROVED	PMR CLASS	SUMMARY OF CHANGES
November 30, 2021	December 21, 2021	1*	Change in designated contract operator from Fluor, Idaho, LLC, to Idaho Environmental Coalition, LLC (IEC), with an effective Revision Date of January 1, 2022.
November 29, 2023	December 5, 2023	1*	Change/Remove permit conditions that are no longer applicable (Permit Modules II.J.2, II.J.4, II.J.5)
December 16, 2025	N/A (effective date of December 17, 2025)	1	- remove references to HWNs that are no longer applicable - update Contingency Plan list of EAMs - update inspection forms to reflect what is most current in EDMS - other Administrative/Informational changes

Appendix 1
CSSF Drawings

RCRA PART B PERMIT REAPPLICATION

FOR THE
IDAHO NATIONAL LABORATORY

VOLUME 22
IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

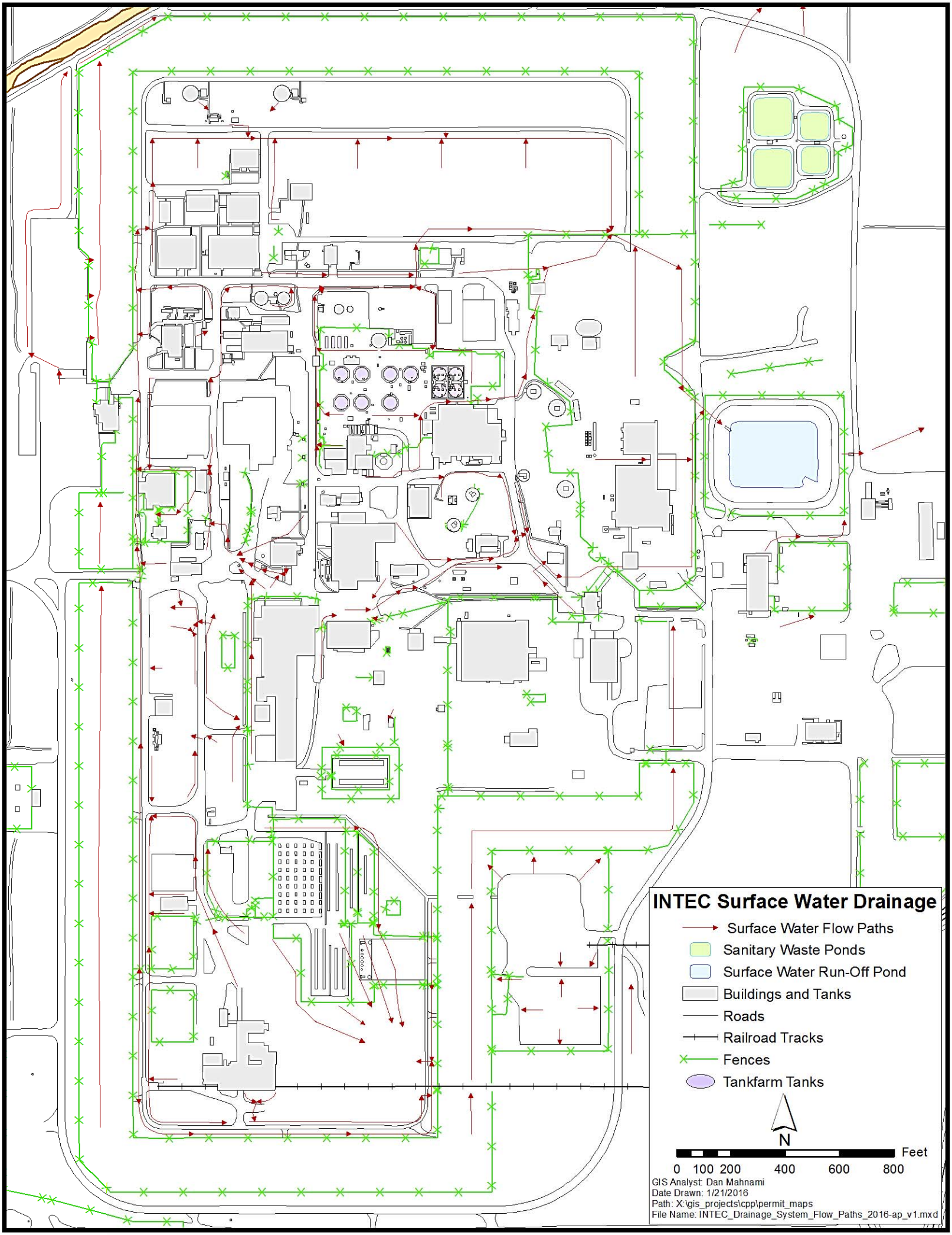
APPENDIX 1

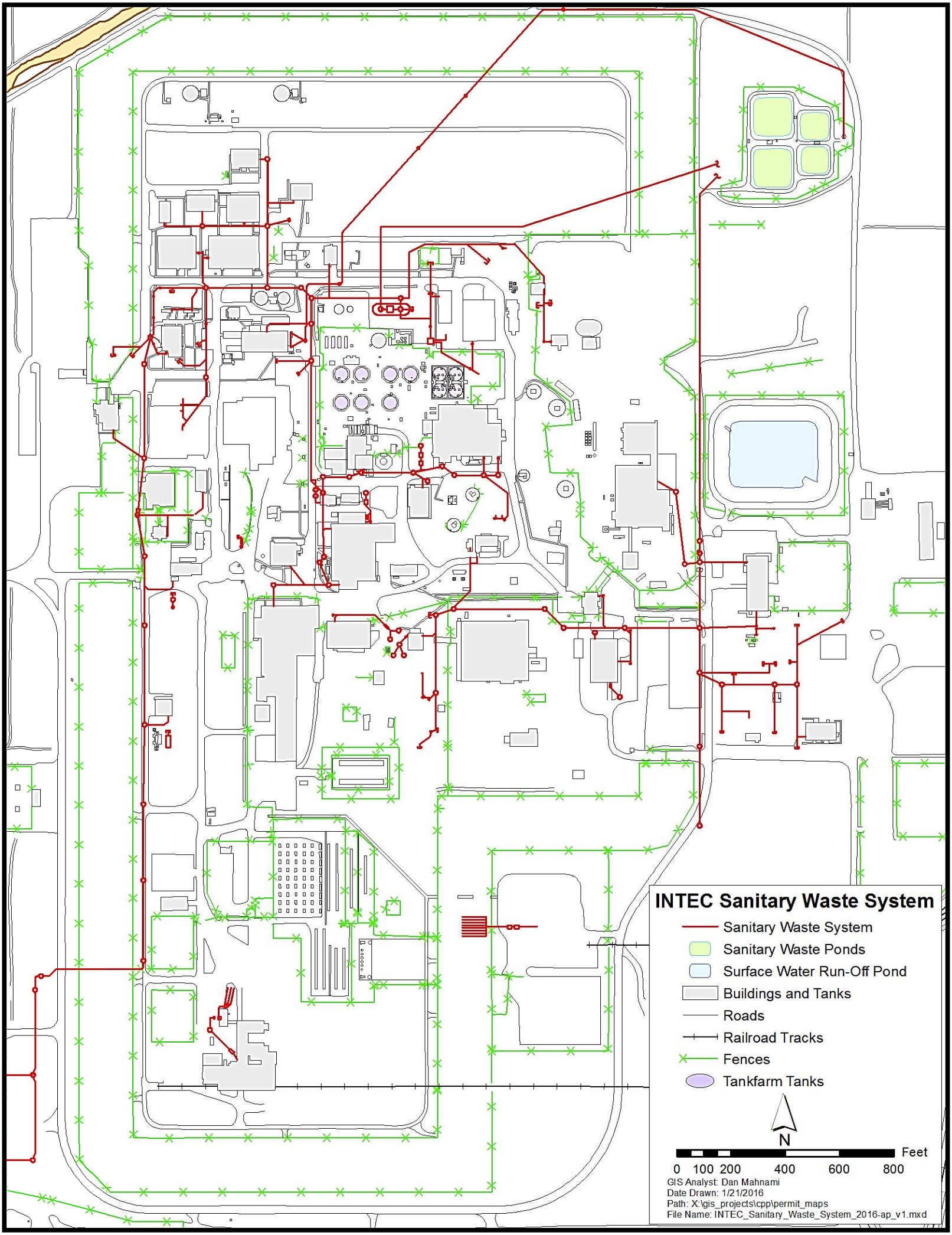
CSSF FACILITY DRAWING LIST
AND DRAWINGS

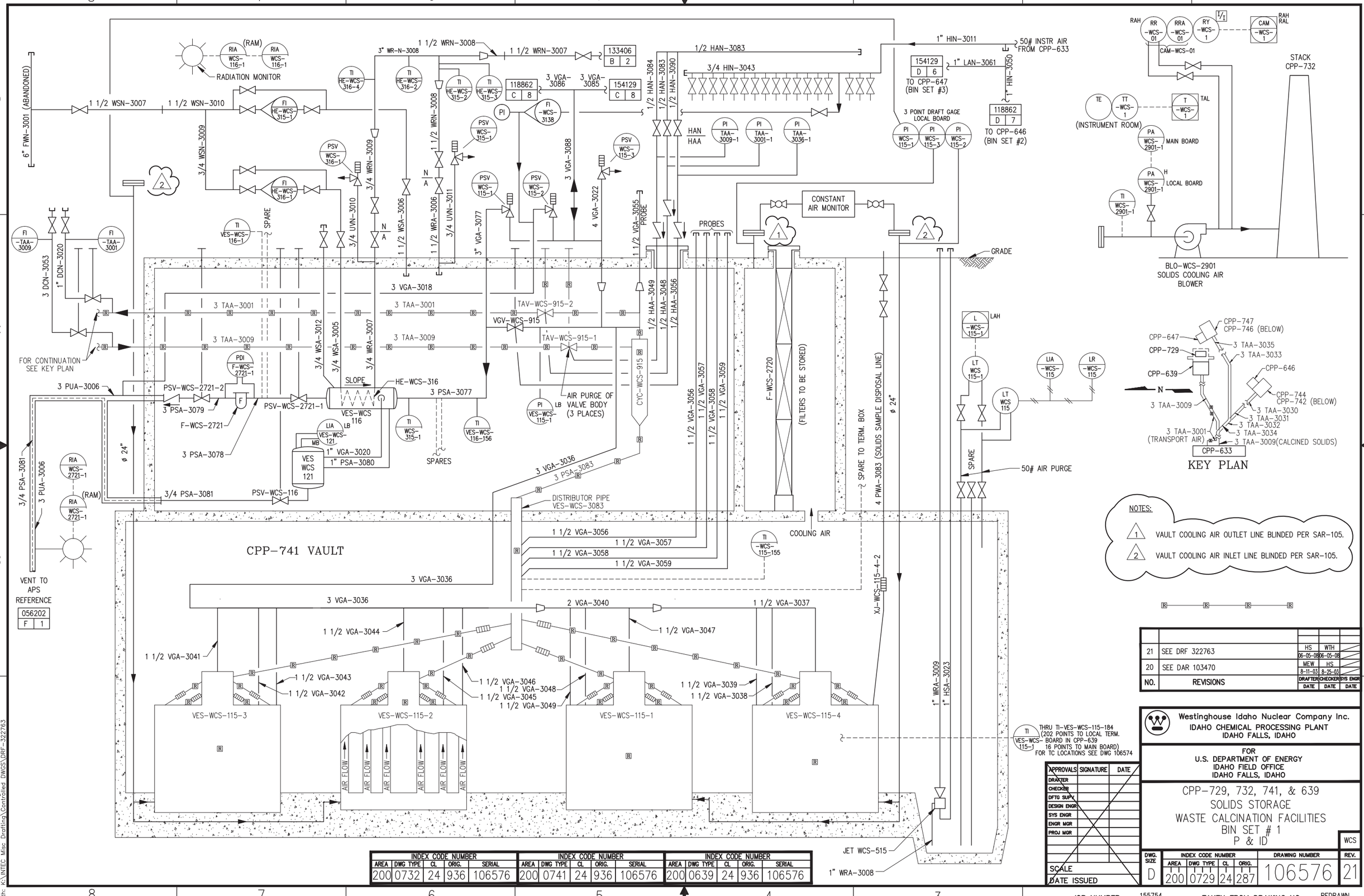
MAY 2016

Drawing List

Drawing No.	Building/Drawing Description	Revision No.
N/A	INTEC Surface Water Drainage System	1/21/2016
N/A	INTEC Sanitary Waste System	1/21/2016
106576	CPP-741 (CSSF 1)	21
106577	CPP-741 (CSSF 1)	8
106574	CSSF-1 Thermocouples	13
118862	CPP-742 (CSSF 2)	12
118871	CPP-742 (CSSF 2)	5
118888	CSSF-2 Thermocouples	6
153510	CPP-746 (CSSF 3)	6
154129	CPP-746 (CSSF 3)	9
154127	CSSF-3 Thermocouples	4
155750	CPP-760 (CSSF 4)	5
157798	CPP-760 (CSSF 4)	20
157814	CSSF-4 Thermocouples	5
158491	CPP-765 (CSSF 5)	31
158510	CPP-765 (CSSF 5)	3
158523	CSSF-5 Thermocouples	5
160283	CPP-791 (CSSF 6)	7
161425	CPP-791 (CSSF 6)	20
161448	CSSF-6 Thermocouples	3
099162	CPP-795 (CSSF 7)	5
165772	CPP-795 (CSSF 7)	5
168211	CSSF-7 Thermocouples	2


INTEC Surface Water Drainage
Surface Water Flow Paths
Sanitary Waste Ponds
Surface Water Run-Off Pond
Buildings and Tanks
Roads
Railroad Tracks
Fences
Tankfarm Tanks
N
Feet
0 100 200 400 600 800
GIS Analyst: Dan Mahnami
Date Drawn: 1/21/2016
Path: X:\gis_projects\cpp\permit_maps
File Name: INTEC_Drainage_System_Flow_Paths_2016-ap_v1.mxd


INTEC Sanitary Waste System
Sanitary Waste System
Sanitary Waste Ponds
Surface Water Run-Off Pond
Buildings and Tanks
Roads
Railroad Tracks
Fences
Tankfarm Tanks
N
Feet
0 100 200 400 600 800
GIS Analyst: Dan Mahnami
Date Drawn: 1/21/2016
Path: X:\gis_projects\cpp\permit_maps
File Name: INTEC_Sanitary_Waste_System_2016-ap_v1.mxd



INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0732	24	936	106576

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0741	24	936	106576

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0639	24	936	106576

NO.	REVISIONS	DRAFTER DATE	CHECKER DATE	SYS ENGR DATE
21	SEE DRF 322763	HS 06-05-08	WTH 06-05-08	
20	SEE DAR 103470	MEW 8-11-03	HS 8-25-03	

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

APPROVALS	SIGNATURE	DATE
DRAFTER		
CHECKER		
DFTG SUPV		
DESIGN ENGR		
SYS ENGR		
ENGR MGR		
PROJ MGR		
SCALE		
DATE ISSUED		

CPP-729, 732, 741, & 639
SOLIDS STORAGE
WASTE CALCINATION FACILITIES
BIN SET # 1
P & ID

DWG. SIZE	INDEX CODE NUMBER AREA	DWG TYPE	CL	ORIG.	DRAWING NUMBER	REV.
D	200	0729	24	287	106576	21

WCS

JOB NUMBER 155754 TAKEN FROM DRAWING NO. REDRAWN

CAD GENERATED - AUTOCAD

File: 106576-21.dwg
Path: K:\INTEC Misc Drafting\Controlled DWGS\DRF-322763
A Date: 06/05/08 - 12:47 PM Layout Name: Model
B By: HSPENCER

FOR OFFICIAL USE ONLY

Sequence of filling:
Group #115-1, 115-2, 115-3, 115-4

NONE - ASME CONSTRUCTION
Spec. # 5775-CPP-P10
+ or - 3.75 650
+ or - 3.3 B50

No
SEE Specifications
B0 B0

None None

unless otherwise noted on Dwg.

14 Plate: ASTM A-240-57T Type 405 *	
15 Tubing: ASTM-A-268-57T Type 405 *	
16 Bolts: ASTM A-193-57T-B6	
17 Nuts: ASTM A-194-57T-6	

* Hot rolled, heat treated, blast cleaned or pickled
** Bins assumed 100% full.
Testing: Bins shall be subjected to a pneumatic test pressure of 4 psig, (external & internal) (See Specifications)
+ Weights are for complete Assembly of 4 Groups, distributor pot & piping

18	Inspected by Fluor's & Customer's inspectors	
19	Total estimated Fabrication Weight	113,000 LBS
+ 20	Estimated operating Weight	528,000 ** LBS

6" Sch. 80 pipe
8'-11½"
Field Splice
Bevel for welding
Sleeve (by others)
To Group "115-4
8 3/4" I diameter holes drilled for thermocouples
1½" (Sch. 80 pipe) Probe Conns (8 required) - Probe Conns to have same slope as feed pipes (Type 304SS)
To Group "115-3
To Group "115-2
To Group "115-1
Type 304 SS.
Field Weld (TYP)
INSTALL 6" SCH. 40 WELD CAP - ASTM-A-182-57T-F6 (EXISTING)
This piping (expansion joints included) Supplied by others installed in field
Group "115-1 - 45°
Group "115-2 - 42°29'
Group "115-3 - 40°11'
(HEAD SHALL BE 405 S.S. MATERIAL AND SHALL HAVE A 3" STRAIGHT FLANGE)
NOTE: AFTER FLANGE REMOVAL, BEVEL VESSEL WALL & HEAD 37½°
TYPE 304 S.S.
Field weld
See Det. "A" Dwg. # 729-P-3
Tan Line
1/16" lifting lugs ½" Wt. 1" dia. hole.
¼" R. (6'-0" course)
REPAIR HOLE LEFT BY ¾" SAMPLE LINE
REMAINDER OF BIN SHOWN BELOW
Thermowell brace
27'-3 5/16" To Tan. Line
26'-9" (Groups 1-4 only)
ASME Flanged + Dished Head ⅜" Min. thickness
Tangent Line
Type 304 SS.
Field weld (Typ)
3½" O.D. Tubing Wt .300" thk. wall
6 feed pipes required
Expansion joint bracing
4 feed pipes required
By Others & Installed by Bin Fabricator
8 radial angles 3"x3"x 5/16" (material ASTM-A7-57T except as noted otherwise, see Dwg. P-2) ¼" E-clips made of 3"x3"x 3/8" angle 3" long for each radial angle (material ASTM-A-240-57T-Type 405)
5'-8" continuous ring
Top ¼" R flanged in & outside corner radius min. 3x thickness. Straight flange min. 1½"
Stiffeners as below (see also dwg # D.3. top lift eye details for top R. thickness under lift eye
36 I.D.
41¾ I.D.
89½ I.D.
93⅜ I.D.
142⅝ I.D.
146⅝ I.D.
⅜" R
¼" R (ASTM-A7-57T)
3-angles 2½"x2½"x 3/16" equally spaced. (ASTM-A 7-57T)
10 radial Stiffeners 5"x 9/16" R. equally spaced
20 radial stiffeners 3"x 9/16" R. equally spaced
Bottom mode of 9/16" R. flanged in & outside corner. Min. radius is 3x thickness. Straight flange min. 1½"
2 - 3½"x ⅜" thk. R. Vacuum Stiffeners Bars
2 - 2"x 1/16" Vacuum Stiffener Bars
2 - angles 3½"x 3½"x ⅜" Vacuum Stiffener Rings (Long leg horizontal)
4'-0"
6'-8"
8'-1"
BIN A-1
BIN A-2
BIN A-3
El. Top of R = 45'-11⅞"
5'-4½" Reference
See Detail "B"
See Det. "E"
Weld pipe to bottom of Tank
5/16" thk. Flanged Head 1½" Straight Flange Inside corner radius = 3x thk.
Radial Support Beams. For orientation See Plan

Sectional Elevation
4-Groups of Bins Required
See Plan for true orientation

Gage line of Bottom & Top radial Beams
18" (Typ)
20 radial stiffeners
90° Typ. 4 pipes
60° Typ. 6 pipes
30° Typ. 10 radial stiffeners
Bottom & Top radial angles 8 required
Top radial angles

Plan

Group "115-4
Group "115-3
Distributor pot
Group "115-1
Group "115-2
Lift eye to be provided in concrete above group "115-4 (by others)

Plan of Solid Storage Assembly

118"-1 Feed pipe
118"-2 Feed pipe
118"-3 Feed pipe
118"-4 Feed pipe

Plan of feed pipe probes

Tapered

Bottom & Top construction for all bins
(Bin A1 without stiffeners)

8" Sch 80 pipe
Supplied by others

Detail E (Note "2)

inside of shroud
Field to fill gap W/ grout as shown
continuous - angle 2½"x2½"x 3/16"
Foundation

Section "E-E"

Shroud
Base R. (by others)
Wall
spacing bar (by others)

Section "A-A"

angle - 4"x3"x¼" 5½" long (ASTM-A-7-57T) Weld angle to shroud
9/16" dia. hole for ¾" dia. ASTM-A-307-57T bolts, for shipping purposes only. Remove after installation of bin
13/16"x1⅛" long slotted hole for ¾" dia. bolt Loosen bolt to hand tight after installation of bin
Bolt ASTM A-193-57T-B6
Nut ASTM A-194-57T-6

Section "C-C"

Bolt (ASTM A-193-57T-B6)
Nut (ASTM A-194-57T-6)
13/16 dia hole (for shipping only)
9/16"x1⅛" slot in clip + 1⅛ dia. hole in beam
Clip. angle 3"x3"x¼" - 6" long (Weld to bottom of bin)
3"x3"x¼" angle
continuous angle 2½"x2½"x⅜"
7 - ¼" R. Gussets E. 1-9/8" R. gusset See Bottom lift eye det. Dwg # 729-P-3
7 - angles 3"x3"x¼" - 3½" long omit angle @ Bottom lift eye

Section "D-D"

Detail "B"

INACTIVE
FOR REF. USE ONLY
This unit superseded by Dwg. No. not shown
Date

CONTROLLED DOCUMENT
CLASS 1
WC RDF

INDEX CODE NUMBER

AREA	DWG. TYP	CL	ORIG	SERIAL
200	0729	53	287	V06577

SOLIDS STORAGE BINS
146"O.D x 20'-0"
(See Note # 10)
£3.75 650

RCRA CONTROLLED DRAWING

	BY	DATE
DRAWN	[redacted]	6-4-58
CHECKED		9-4-58
APPROVED		9-22-58
APPROVED		9-23-58
APPROVED		
APPROVED		
AEC APPROVED		11-14-58
AEC APPROVED		

SCALE: NOT TO SCALE
DATE: 11-14-58

Notes:
1 Gaskets for "Triple Run" to be Garlock #7022 or equal
2 Slide R. & centering cone supplied by others
3 Bolts are ¾" ø
4 Material of bolts used for shipping only: ASTM-A-7-57T
5 Top radial angles for shipping & installation purposes only. Remove after installation.
6 Clips connecting shroud to bottom radial beams for shipping & installation purposes only. Remove bolts after installation of Bins
7 After installation remove shipping bolts in clips connecting bins to bottom radial beams then loosen bolts in slotted holes (hand tight)
8 Cut bracings of expansion joints after installation
9 For connections & Lift eye details see Dwg # - CPP-729-P-3
10 One name plate reqd for each of the four Groups. Group numbers to be:
5775-WC-115-1
5775-WC-115-2
5775-WC-115-3
& 5775-WC-115-4
11 All nozzle openings to be 100% reinforced except thermo wells. (See thermo-well detail)
12 Field welding shall be in accordance W/ Paragraph P10-7 of specification 5775-CPP-P10

AS BUILT

NO.	DATE	DESCRIPTION	DWN	CHK	APPVD.	APPVD.
8	6-24-94	REVISED PER DCN# 155754-AB46	MW			
7	4-1-94	ACTIVATED PER DCN# 155754-AB46	JPD		RDA	

REVISIONS

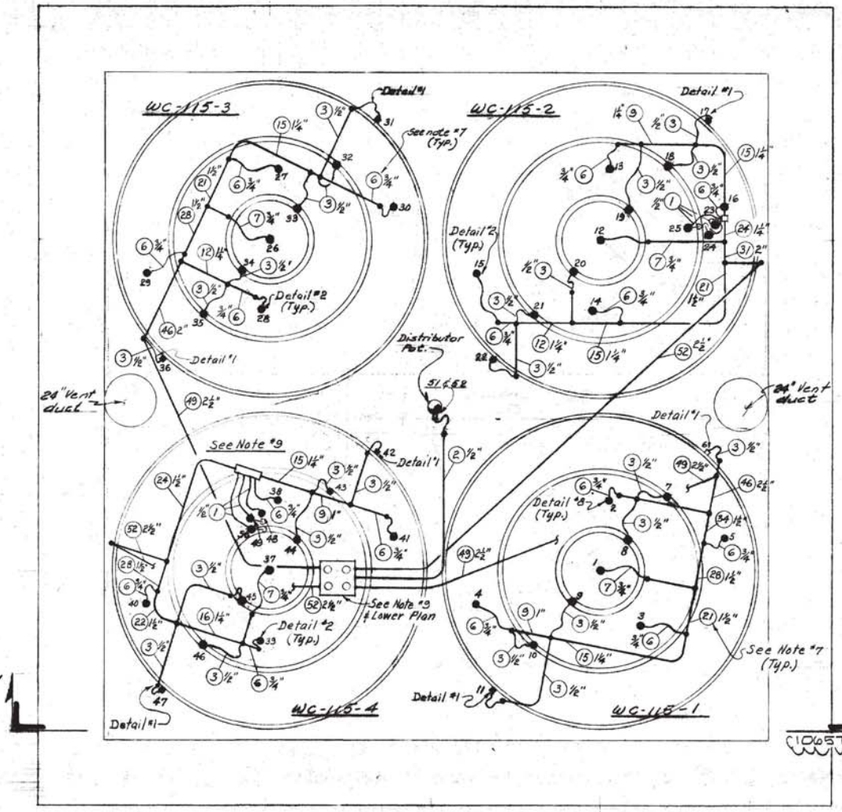
CPP-729 BIN SET 1 VESSEL
VES-WC-115-1,2,3&4
SOLIDS STORAGE BINS
WASTE CALCINATION FACILITIES

THE FLUOR CORPORATION LTD.
ENGINEERS AND CONSTRUCTORS
LOS ANGELES CALIFORNIA
FOR
U.S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

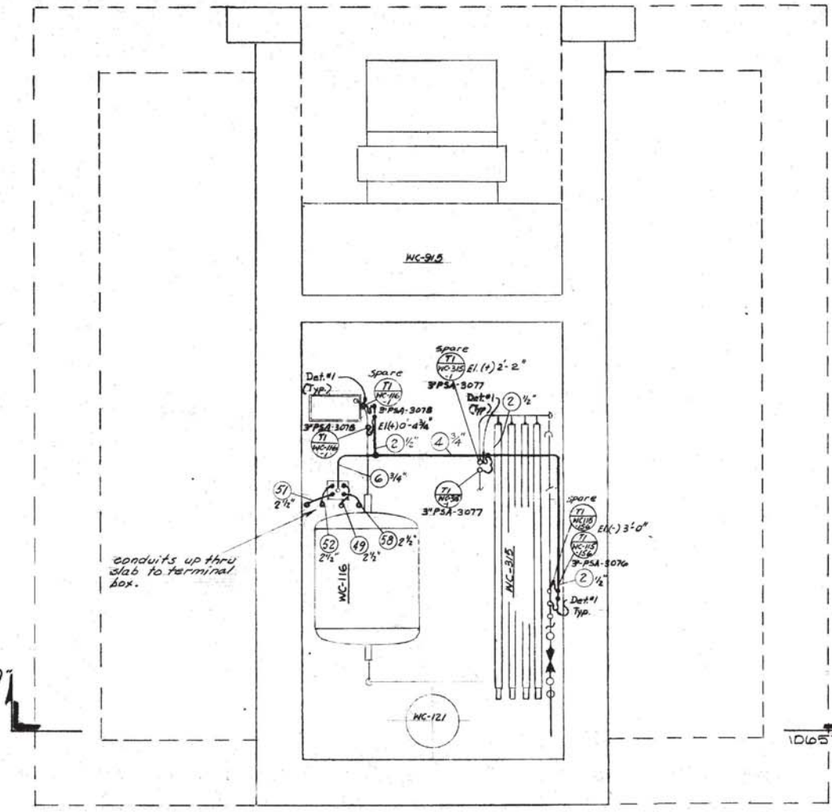
DWG. No. 5775-CPP-729-P-2 REV. 8

FOR OFFICIAL USE ONLY

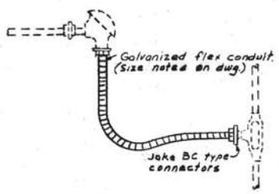
FOR OFFICIAL USE ONLY



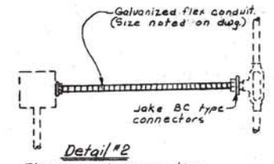
Plan Of Solids Storage Bins
(Indicating thermocouple connections)
Scale: 3/16" = 1'-0"



Lower Plan El(+) 4'-10" to (-) 4'-11"
Scale: 3/8" = 1'-0"



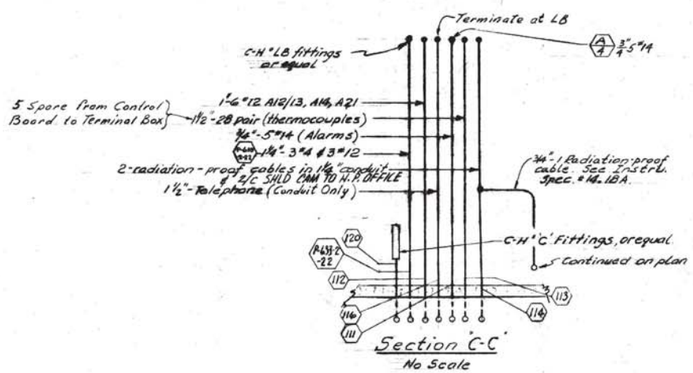
Detail #1
Thermocouple Connection



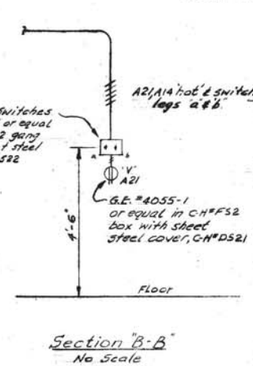
Detail #2
Thermocouple Connection

Notes

1. For material see Bill of material #729-E-1 (Separate sheet)
2. For Leg paint schedule, see dwg. #633-E-6.
3. Numbers shown refer to thermocouples location.
   For the number and tag of thermocouples in each location see Instru. spec. #5115-CPP-TF sheet #E.01F
4. All conduit to be rigid steel, galvanized, unless noted.
5. All conduit fittings to be Crouse-Hinds Obround, or equal.
6. All thermocouple wire to be #16 Ga.
7. (4) ¼" Signifies 4 pair thermocouple wire in ½" conduit. typical.
8. For notes & symbols see dwg. #401-S.
9. Continue Conduits to Pull Box Shown in Section "AA" on Drawing 106575, Where Wires Shall be Rearranged to Enter Thermocouple Terminal Box in Correct Order.



Section "C-C"
No Scale



Section "B-B"
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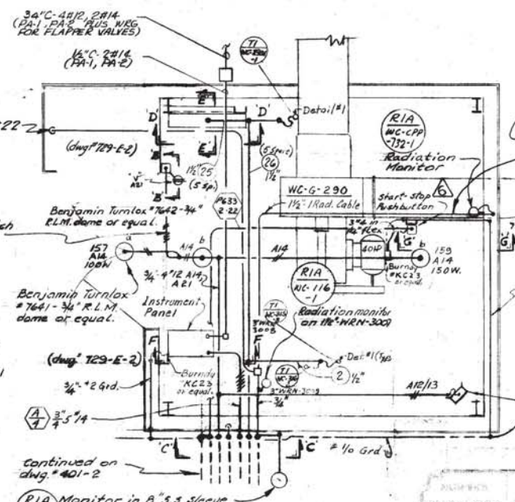

Upper Plan El(+) 4'-10" And Above
Scale: 3/8" = 1'-0"

CONTROLLED DOCUMENT

CLASS I

INDEX CODE NUMBER

SYS	CODE	SERIAL
200	0723	10287 106574

RCRA CONTROLLED DRAWING

AS BUILT

INACTIVE
FOR REF. USE ONLY
This Dwg. Superseded By:
Dwg. No. NOT SUPERSEDED
Date

NO.	DATE	DESCRIPTION	LOC.	APPVD	AEC APPVD
13	6-23-59	REVISED PER DCN #55754-AB40			
12	5-26-59	REVISED PER DCN #55754-AB22			
11	9-20-58	INACTIVATED			
10	5-29-58	SEE DCN 729-0227			
9	10-25-57	SEE DCN 729-E			
8	8-26-57	SEE DCN #V-BYDCP			

REVISIONS

CPP-729 BIN SET #1

ELECTRICAL PLANS AND THERMOCOUPLE CONNECTIONS WASTE CALCINATION FACILITIES

THE FLUOR CORPORATION LTD.
ENGINEERS AND CONSTRUCTORS
LOS ANGELES CALIFORNIA

U.S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

DWG. No. 5775-CPP-729-E-1 REV. 13

	BY	DATE
DRAWN	[redacted]	8-13-58
CHECKED	[redacted]	10-28-58
APPROVED	[redacted]	11-14-58
APPROVED	[redacted]	12-29-58
APPROVED		
APPROVED		
APPROVED		
AEC APPROVED	[redacted]	1-15-59
AEC APPROVED		
SCALE: AS NOTED		
DATE: 1-15-59		

DRAWING REFERENCE DRAWINGS

5775-CPP-729-E-2 Sections & Details
5775-CPP-401-2 Electrical Underground Plan
5775-CPP-729-S2 Plans & Elev. (+) 4'-10" to (-) 4'-11"
5775-CPP-729-P-10 Piping Plan "D"
5775-CPP-401-4 Electrical conduit schedule
5775-CPP-401-S Electrical Notes & Symbols

FOR OFFICIAL USE ONLY

106576 D 3

1" HIN-3050 (AIR SUPPLY CAPPED NEAR 1"HIN-3011)

TO THERMOCOUPLE TI-VES-WCS-136-285

1/2" HIN-3057

1/2" HIN-3056

1" HIN-3050 (INST. AIR HDR.)

ROD OUT LINES (CLEANOUT)

CPP-744

INST. BLDG. CPP-646

1/2" HAA-3097

1/2" HAA-3096

1/2" HAA-3092

1/2" HIN-3059

1/2" HIN-3060

FI -WCS-TAV-1

FI -WCS-TAV-2

FI -WCS-3030

FI -WCS-3031

L -WCS-742-1

LAH

RAD MONITOR LINES

LIA -WCS-742 (LSH)

LIA -WCS-742 (LI)

LT -WCS-742-1 (LT)

PIAH -WCS-136

PIA -WCS-136

PIAL -WCS-136

1" DCN-3112

106576 D 5

3" VGA-3086

P-WS2-LA

TI -WC-100

TO TC (TI-WCS-136-201) THRU (TI-WCS-136-223) & TC (TI-WCS-136-226) THRU (TI-WCS-136-264) (IN STORAGE BINS & CONCRETE)

TO TC (TI-WCS-136-284)

TO TC (TI-WCS-136-286)

TO ATMOSPHERE

36" ø COOLING AIR STACK

T -WCS-2 TAL

TE

TT -WCS-2

TI VES-WCS-136-B

TO TC (TI-WCS-136-268) THRU (TI-WCS-136-282) IN EARTH

TO TC (TI-WCS-136-283)

TO TC (TI-WCS-136-224,225)

1" DCA-3130

1/4" DCN-3114

1" DCA-3132

3" TAA-3031

TAV-WCS-2

1 1/2" VGA-3087

VALVE STEM

3" VGA-3087

TO TC TI-WCS-PI-001 THRU 080

1/2" HAA-3091

1/2" HIN-3052

1/2" HIN-3055

1" DCN-3113

1/4" DCN-3115

1" DCN-3110

3" TAA-3030

1" DCA-3131

TAV-WCS-1

1/2" HAA-3050

1/2" HAA-3092

1 1/2" VGA-3089

1 1/2" VGA-3090

1 1/2" VGA-3095

1 1/2" VGA-3094

CYC-WCS-911

1 1/2" VGA-3093

1 1/2" VGA-3091

1 1/2" VGA-3092

1/2" HAA-3093

3" VGA-3086

PI -WCS-911

PDR -WCS-911

PI -WCS-TAV-2

PI SP-WCS-136

FI SP-WCS-136

1/2" HIN-3054

RY -WCS-2

RR -WCS-02

RRA -WCS-02

CAM -WCS-02

CAM -WCS-2

RAH RAL

RAH

1/2" HIN-3094

PI -WCS-742-2

F-WCS-2727 WITH BLIND INSTALLED TO CLOSE

R G

V-WCS-1

S

PI -WCS-742-1

FOR CONTINUATION SEE KEY PLAN

6" COUPON SAMPLE LINE

TI -WCS-136-A

PI -WCS-TAV-1

1/2" HIN-3051

6" COUPON SAMPLE LINE

TO TC-WCS-136-101 THRU 136-169 (SEE DWG. 118888 FOR LOCATIONS)

3" VGA-3084

3" VGA-3084

6" VGA-3074

1 1/2" VGA-3081

6" VGA-3072

1 1/2" VGA-3079

6" VGA-3073

1 1/2" VGA-3080

VES-WCS-137

1 1/2" VGA-3077

1 1/2" VGA-3083

1 1/2" VGA-3082

1 1/2" VGA-3078

6" VGA-3070

6" VGA-3071

6" VGA-3076

6" VGA-3075

XJ-WCS-6-2

XJ-WCS-6-1

XJ-WCS-136-5

XJ-WCS-136-4

XJ-WCS-136-3

XJ-WCS-136-1

XJ-WCS-136-2

XJ-WCS-136-6

XJ-WCS-136-7

VES-WCS-136-5

VES-WCS-136-3

VES-WCS-136-4

DIVERTER VALVES

VES-WCS-136-1

VES-WCS-136-2

VES-WCS-136-7

VES-WCS-136-6

STORAGE VAULT CPP-742

1 1/2" WRA-3042

1 1/2" HSA-3050

1 1/2" WRA-3041

JET WCS-522

1 1/2" WRA-3040

RADIATION MONITOR LINES

1/4" INSTRUMENT PROBES

ø 26" DUCT

ACCESS HATCH

CPP-747

CPP-746 (BELOW)

CPP-647

3 TAA-3035

3 TAA-3033

CPP-729

CPP-639

CPP-646

CPP-744

CPP-742 (BELOW)

N

3 TAA-3009

3 TAA-3030

3 TAA-3031

3 TAA-3032

3 TAA-3001 (TRANSPORT AIR)

3 TAA-3034

3 TAA-3009(CALCINED SOLIDS)

CPP-633

KEY PLAN

RCRA CONTROLLED

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0646	24	613	118862

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
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12	SEE DRF-326836	HS 07-01-09	EEE 07-16-09	
11	SEE DAR 116595	DEJ 11-3-04	DEJ 11-4-04	

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

CPP-742, 744 & 646 ADDITIONAL CALCINED WASTE STORAGE FACILITIES BIN SET #2 P & ID

WCS

APPROVALS	SIGNATURE	DATE
DRAFTER		
CHECKER		
DFTG SUPV		
DESIGN ENGR		
SYS ENGR		
ENGR MGR		
PROJ MGR		

SCALE NONE

DATE ISSUED

DWG. SIZE	INDEX CODE NUMBER AREA	DWG TYPE	CL	ORIG.	DRAWING NUMBER	REV.
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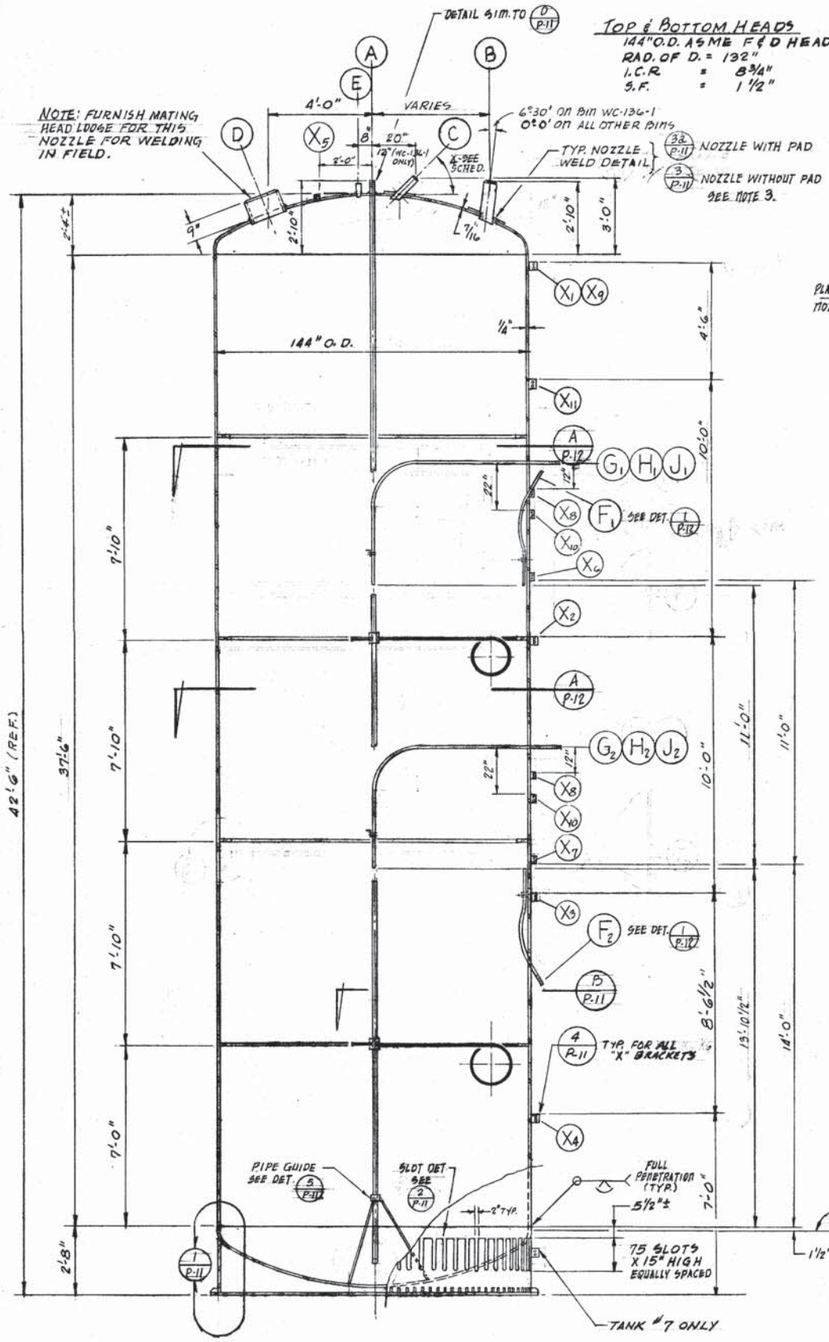
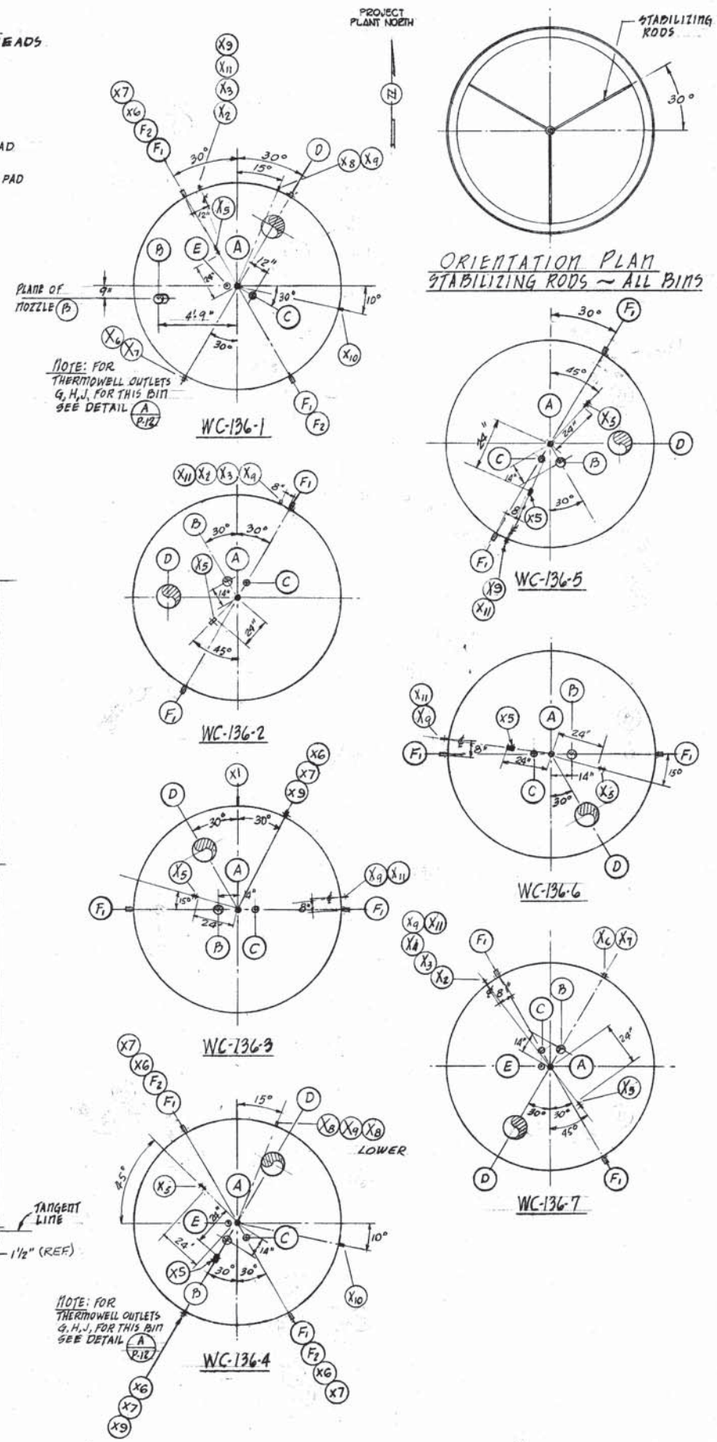
B By: HSPENCER



SOLIDS STORAGE BIN (1 P-10)

SCALE: 3/8" = 1'-0"

FOR NOZZLE ORIENTATION SEE INDIVIDUAL STORAGE BIN PLAN



NOZZLE ORIENTATION PLANS

NO SCALE

NOZZLE SCHEDULE

ITEM	IDENTITY	SIZE	BIN NO.	REMARKS
A	THERMO-WELL	1½" SCH. 160 S	ALL BINS	LOCATED ON CENTER LINE OF BIN
B	SOLIDS REMOVAL	6" SCH. 40 S	ALL BINS	TANK VENTED THRU THIS NOZZLE.
C	FILL LINE	3" SCH. 40 S	ALL BINS	FOR ANGLE OF NOZZLE SEE SCHEDULE BELOW
D	MANWAY	18" O.D. x 1/4" WALL	ALL BINS	18"x¼" WALL ASME. F&D (W/ BEVEL EDGE) HEAD W/ 1½" STRAIGHT FLANGE. FURNISH LOOSE.
E	THERMO-WELL		WC-136-1 WC-136-4 WC-136-7	TRINITY THERMOCOUPLE WELL CAT. NO. T-141-3"-30455 OR EQUAL.
F1 F2	THERMO-WELL	1/2" SCH. 160 S	F1 - ALL BINS F2 - WC-136-1 WC-136-4	SEE DETAIL 1 P-12
G1 H1 J1 G2 H2 J2	THERMO-WELL	1/2" SCH. 160 S	WC-136-1 WC-136-4	SEE SECTION A P-12 FOR ORIENTATION USED ON BINS 136-1 & 4 ONLY
X	SUPPORT BRACKET		ALL BINS	SEE DETAIL 4 P-11

NOZZLE 'C' SCHEDULE

NOTE: THE VERTICAL ANGLE OF NOZZLE 'C' IS MEASURED WITH THE HORIZONTAL AND IN THE PLANE OF THE NOZZLE & THE BIN ℄. ANGLE TOLERANCE IS ± 1/2 DEGREE.

BIN NO.	ANGLE
WC-136-1	90°- 0'
WC-136-2	45°- 0'
WC-136-3	51°- 0'
WC-136-4	49°- 0'
WC-136-5	52°-30'
WC-136-6	55°- 30'
WC-136-7	54°- 0'

NOTES.

1. BINS SHALL BE FURNISHED IN ACCORDANCE WITH SPECIFICATION P-7
2. SUPPORT BRACKET 'X' NOS. SIGNIFY LOCATION ON BINS
3. WHERE NOZZLES REQUIRING REINFORCING PADS HAVE ℄'S LESS THAN 18" APART, USE A COMMON PAD BETWEEN NOZZLES. PADS MAY BE SEGMENTED PROVIDED THAT THEY ARE MADE INTEGRAL BY MEANS OF FULL PENETRATION WELDS OF THE RADIAL JOINTS TO THE HEAD MATERIAL.

RCRA CONTROLLED DRAWING

NO.	DATE	DESCRIPTION	LOC.	APP'D.	AEC APP'D	PPCO. APP'D.
5	6-21-94	REVISED PER DCN # 155754-AB13	JPD			
4	4-1-94	PER DCN # 155754-AB7	JPD			
3	3-22-93	INACTIVATED	KWG			
2	8-3-66	AS BUILT				
1	3-25-66	GALVANIZED SQUARE SUPPORT BRACKET LUGS				

REVISIONS

ADDITIONAL CALCINED WASTE STORAGE FACILITIES
SOLIDS STORAGE BINS

NORMAN ENGINEERING CO.
consulting engineers
LOS ANGELES, CALIFORNIA

FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

DWG. NO 1200-CPP-742-P-10 REV. 5

CONTROLLED DOCUMENT

CLASS I

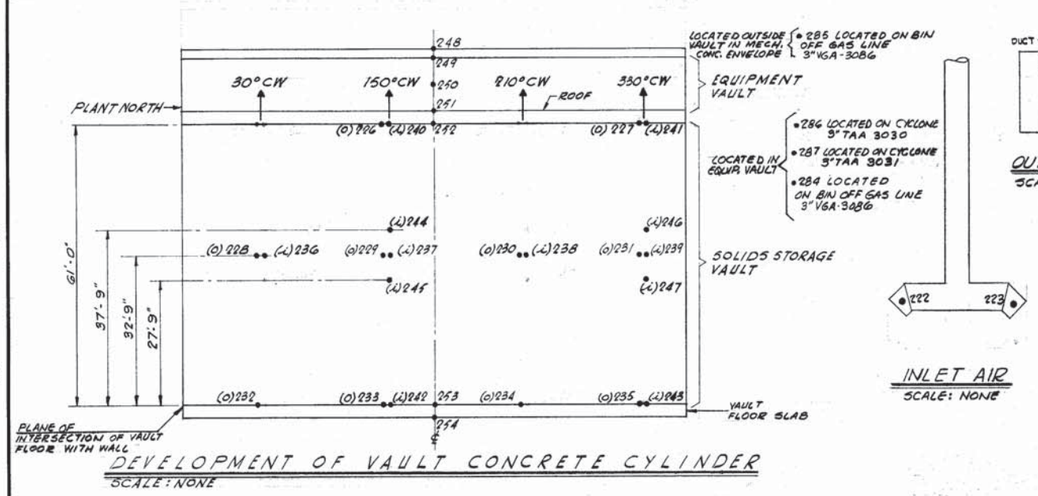
	BY	DATE
DRAWN	D.L.BWID	6/10/64
CHECKED	O. SCHR	12-4-64
APPROVED	J. Goff	12-4-64
APPROVED		12-4-64
APPROVED		
APPROVED		
PPCO. APP'D.	K.W.R.	1-22-65
AEC APPROVED	A.L.D.	1-22-65
AEC APPROVED	D.D.O.	1-22-65
SCALE:	NOTED	
DATE:	1-22-65	

WCS

INDEX CODE NUMBER

AREA	DWG. TYPE	CL	ORIG.	SERIAL
200	0742	5	613	118871

CONTRACT AT (10-1) 1180

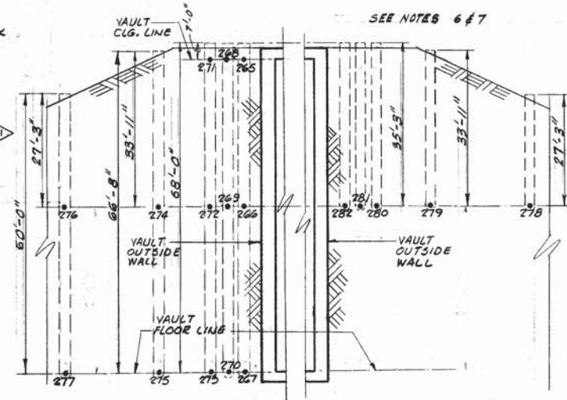


DEVELOPMENT OF VAULT CONCRETE CYLINDER
SCALE: NONE



OUTLET AIR
SCALE: NONE

INLET AIR
SCALE: NONE



SECTION A
SCALE: NONE

SECTION B
SCALE: NONE

NOTES:

1- ONLY THE LAST THREE NUMBERS OF EACH THERMOCOUPLE NUMBER ARE USED. A COMPLETE THERMOCOUPLE NUMBER IS TI-WC-136-101.

2- ALL 100 SERIES THERMOCOUPLES ARE CONNECTED TO TEMPERATURE INDICATOR TI-WC-136-1 WITH A SCALE OF 0-2000°F.

3- ALL 200 SERIES THERMOCOUPLES ARE CONNECTED TO TEMPERATURE INDICATOR TI-WC-136-2 WITH A SCALE OF 0-800°F.

4- THERMOCOUPLE NUMBER WITH PREFIX (L) MEANS THAT THE THERMOCOUPLE IS LOCATED APPROXIMATELY 2" INSIDE THE INSIDE EDGE OF CONCRETE.

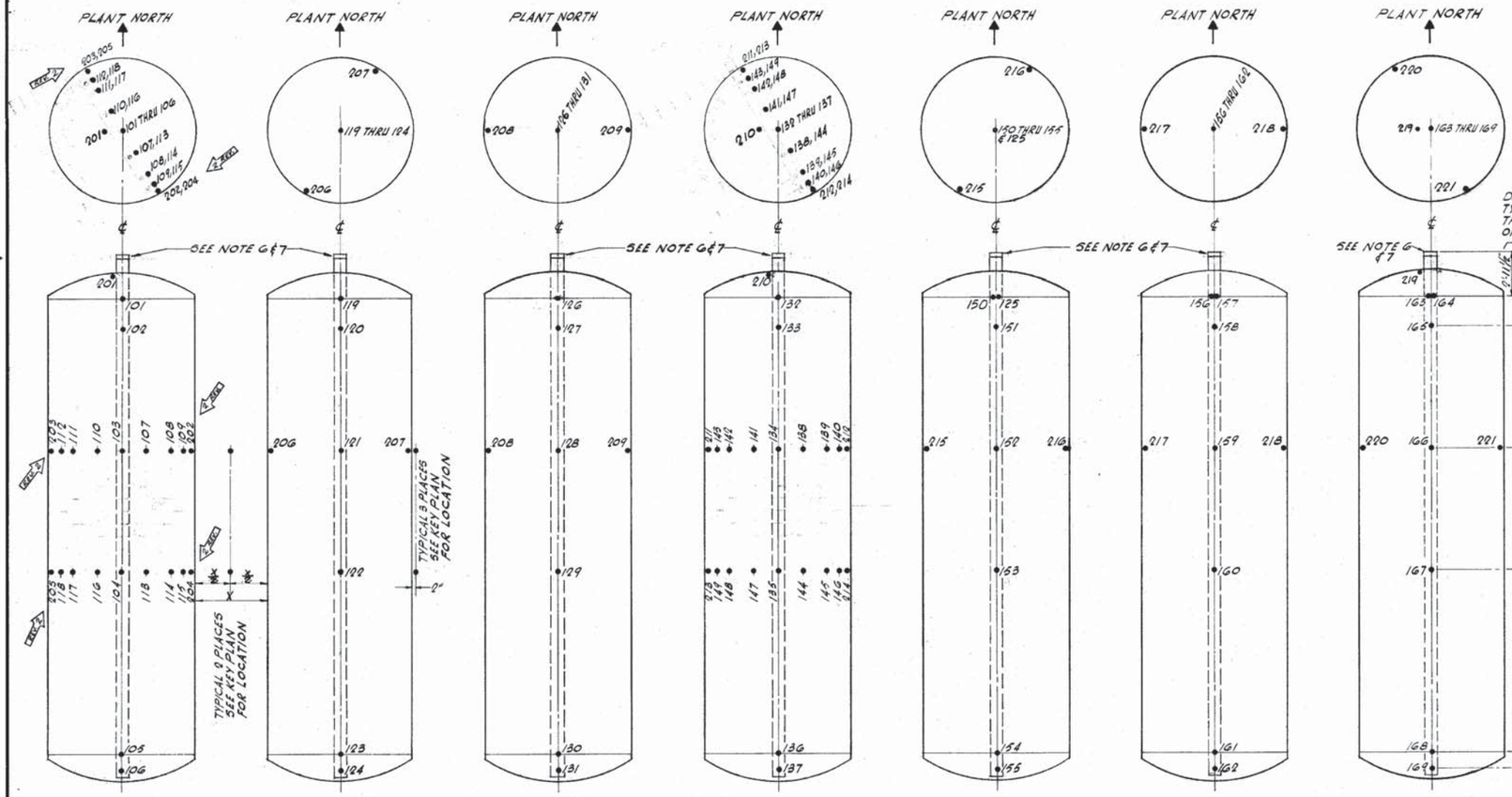
5- THERMOCOUPLE NUMBER WITH PREFIX (O) MEANS THAT THE THERMOCOUPLE IS LOCATED APPROXIMATELY 2" INSIDE THE OUTSIDE EDGE OF CONCRETE.

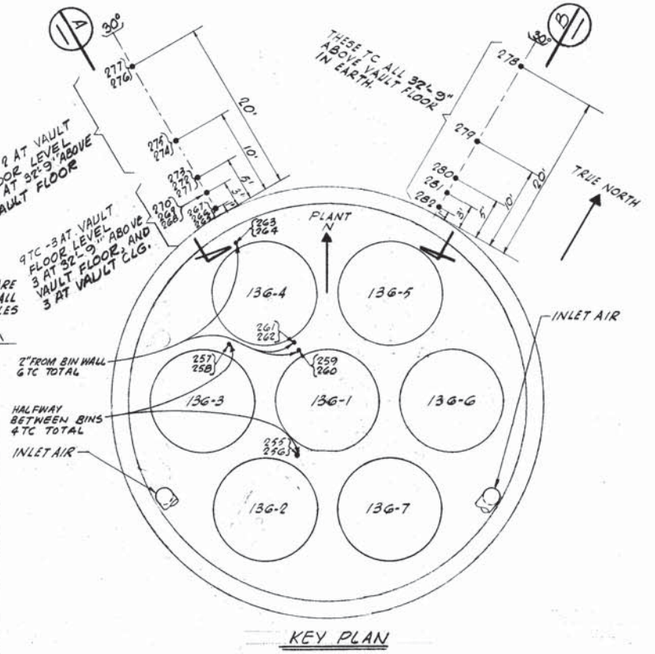
6- MULTIPOINT THERMOCOUPLE ASSEMBLY. ALL DIMENSIONS ARE SHOWN FROM THREADED END OF THERMO WELL. THERMOCOUPLE ASSEMBLY TO BE SUPPLIED WITH MATCHING UNION.

7- MULTIPOINT THERMOCOUPLES IN VERTICAL CENTER LINE OF BIN TO BE 1/4". ALL OTHERS TO BE 1/8" OUTSIDE DIAMETER.

8- FOR SCHEDULE OF TC 255 THRU 264 SEE DWG# 1200-CPP-742-E-1.

9- FOR LEGEND SEE DWG# 1200-CPP-401-1.





KEY PLAN

RCRA CONTROLLED DRAWING

INACTIVE
FOR REF. USE ONLY
This Dwg. Superseded By:
Dwg No. NOT SUPERSEDED
Date 8-22-82

CONTROLLED DOCUMENT CLASS I

NO.	DATE	DESCRIPTION	LOC.	APPVD.	AEC APPVD	PPCO. APPVD.
6	6-24-94	REVISED PER DCN# 155754-AB44	NW			
5	5-26-94	REVISED PER DCN# 155754-AB25				
4	9-22-82	INACTIVATED	KWR			
3	4-66	AS BUILT				
2	9-28-65	CHG'D TC NOS. ON BIN WC-136-1				KWR
1	6-2-65	CHG'D DWG. SECT. A & B				KWR

REVISIONS

	BY	DATE
DRAWN	G.Gossman	12-19-64
CHECKED	W.GEMMELL	2-19-65
APPROVED		2-15-65
APPROVED		4-23-65
APPROVED		
APPROVED		
PPCO. APPVD.	KWR	4-22-65
AEC APPROVED	D.Bodenhamer	4-23-65
AEC APPROVED	DDD	4-23-65

CPP-742
ADDITIONAL CALCINED WASTE STORAGE FACILITIES
BIN SET # 2
THERMOCOUPLE LOCATIONS

NORMAN ENGINEERING CO.
consulting engineers
LOS ANGELES, CALIFORNIA
FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

WCS
INDEX CODE NUMBER

AREA	DWG. TYPE	CL	ORIG.	SERIAL
200	0742	25	613	118888

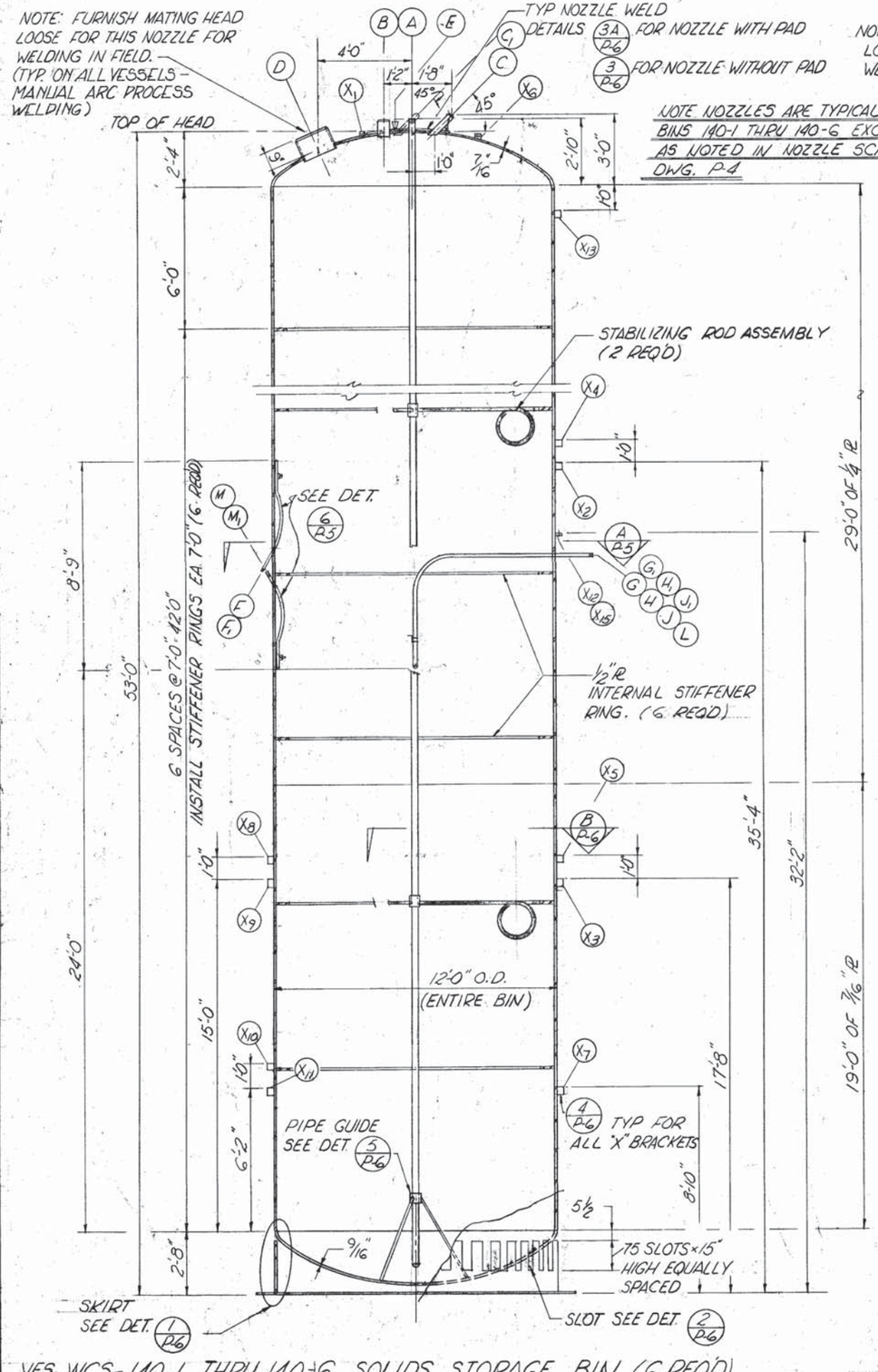
SCALE: NONE
DATE: 4-23-65
DWG. NO. 1200-CPP-742-T-1
REV. 6

CONTRACT AT (10-1) 1180

NOTE: FURNISH MATING HEAD LOOSE FOR THIS NOZZLE FOR WELDING IN FIELD. (TYP. ON ALL VESSELS - MANUAL ARC PROCESS WELDING)

TYP NOZZLE WELD DETAILS (3A P-6) FOR NOZZLE WITH PAD; (3 P-6) FOR NOZZLE WITHOUT PAD

NOTE NOZZLES ARE TYPICAL FOR BINS 140-1 THRU 140-6 EXCEPT AS NOTED IN NOZZLE SCHEDULE DWG. P-4



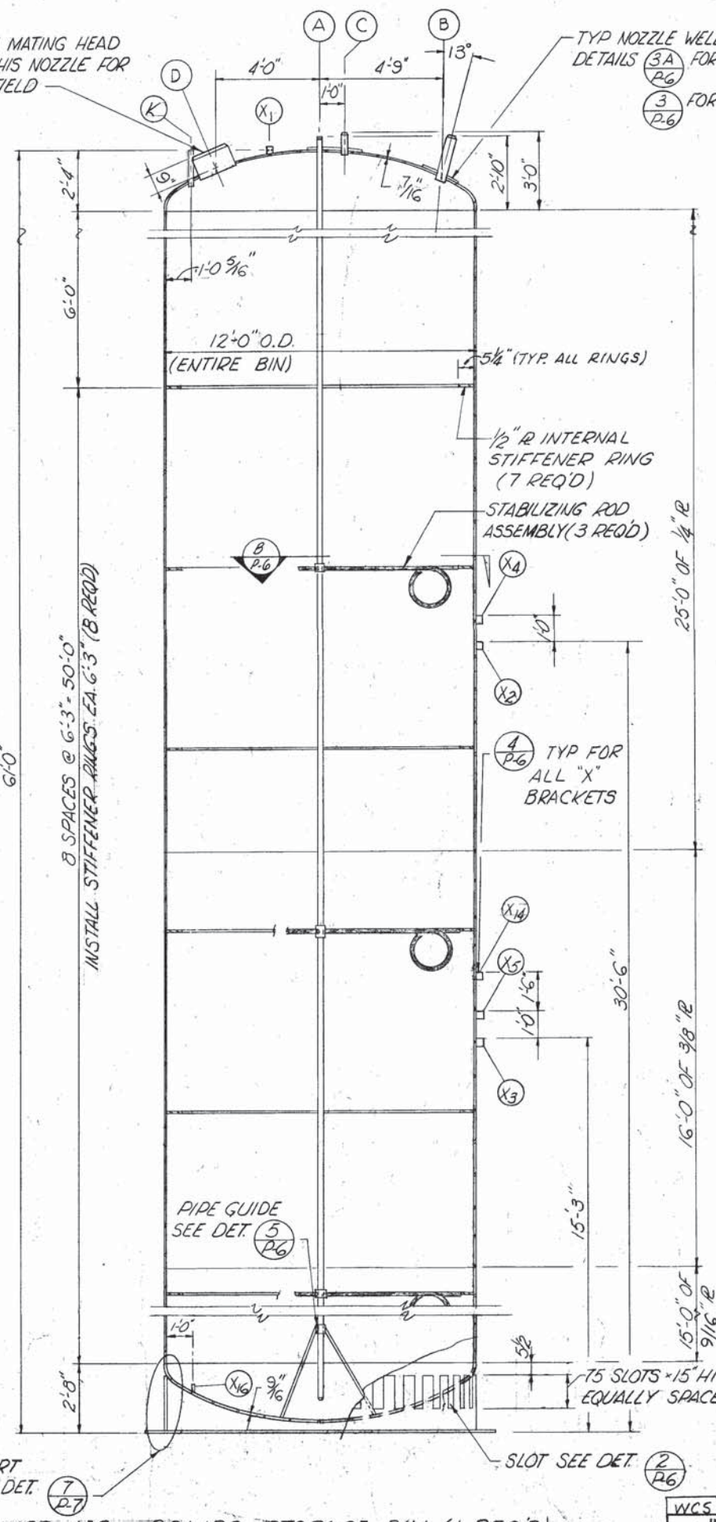
VES-WCS-140-1 THRU 140-6 SOLIDS STORAGE BIN (6 REQ'D)

SCALE: 3/8"=1'-0"

NUCLEAR QUALITY ASSURANCE ESSENTIALITY LEVEL: III

NOTE: FURNISH MATING HEAD LOOSE FOR THIS NOZZLE FOR WELDING IN FIELD

TYP NOZZLE WELD DETAILS (3A P-6) FOR NOZZLE WITH PAD; (3 P-6) FOR NOZZLE WITHOUT PAD

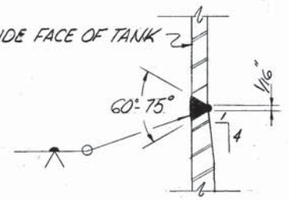


VES-WCS-139 SOLIDS STORAGE BIN (1 REQ'D)

SCALE: 3/8"=1'-0"

RCRA CONTROLLED DRAWING

TOP & BOTTOM HEADS
144" O.D. ASME F & D HEADS
RAD OF D = 132"
I.C.R. = 8 3/4"
S.F. = 1 1/2"



TYP JOINT DETAIL WHERE SHELL THICKNESS CHANGES

NOTES

1. SEE SPECIFICATIONS FOR MATERIALS AND PROCEDURES USED IN TANK FABRICATION.
2. BRACKET "X16" IS TO BE LOCATED DIRECTLY UNDER NOZZLE "K"
3. BINS SHALL BE GOVERNMENT FURNISHED & CONTRACTOR INSTALLED. DRAWINGS P-3 THRU P-7 ARE FOR INSTALLATION ONLY.
4. FOR NOZZLE ORIENTATION SEE INDIVIDUAL STORAGE BIN PLAN DWG. P-4
5. ALL NOZZLES AND THERMOCOUPLE WELL AT HEAD ARE TO PENETRATE THRU HEAD 1/2".
6. BIN WORKING TOLERANCES ARE TO BE: OVERALL HEIGHT ± 1/8", MISALIGNMENT OF ℄ W/ REFERENCE TO TOP ℄ BOTTOM ± 1/8", ℄ NOZZLE LOCATION ± 1/8"
7. WELD SYMBOLS PER ASA Y32.3

NO.	DATE	REVISIONS	BY	DATE	APPVD. INC	APPVD. IDAHO	APPVD. AEC	APPVD. H&S	APPVD. E&C
6	6-24-71	REVISED PER DCN #135754: AB 45 MN		6-24-71		6-24-71			

	BY	DATE
DESIGNED	L Terry	3-7
DRAWN	W.A. MILLER	12-7-67
CHECKED		2-9-68
APPROVED		3-13-68

APPROVALS		
ORGAN.	BY	DATE
INC		2-21-68
QA		2-13-68
SS		2/13/68
IDAHO		2-13-68
AEC		
AEC H&S		
AEC E&C		2/14/68

CONTROLLED DOCUMENT

CONTROLLED DOCUMENT CLASS I

CLASS I

IDAHO NUCLEAR CORPORATION
IDAHO FALLS, IDAHO
FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

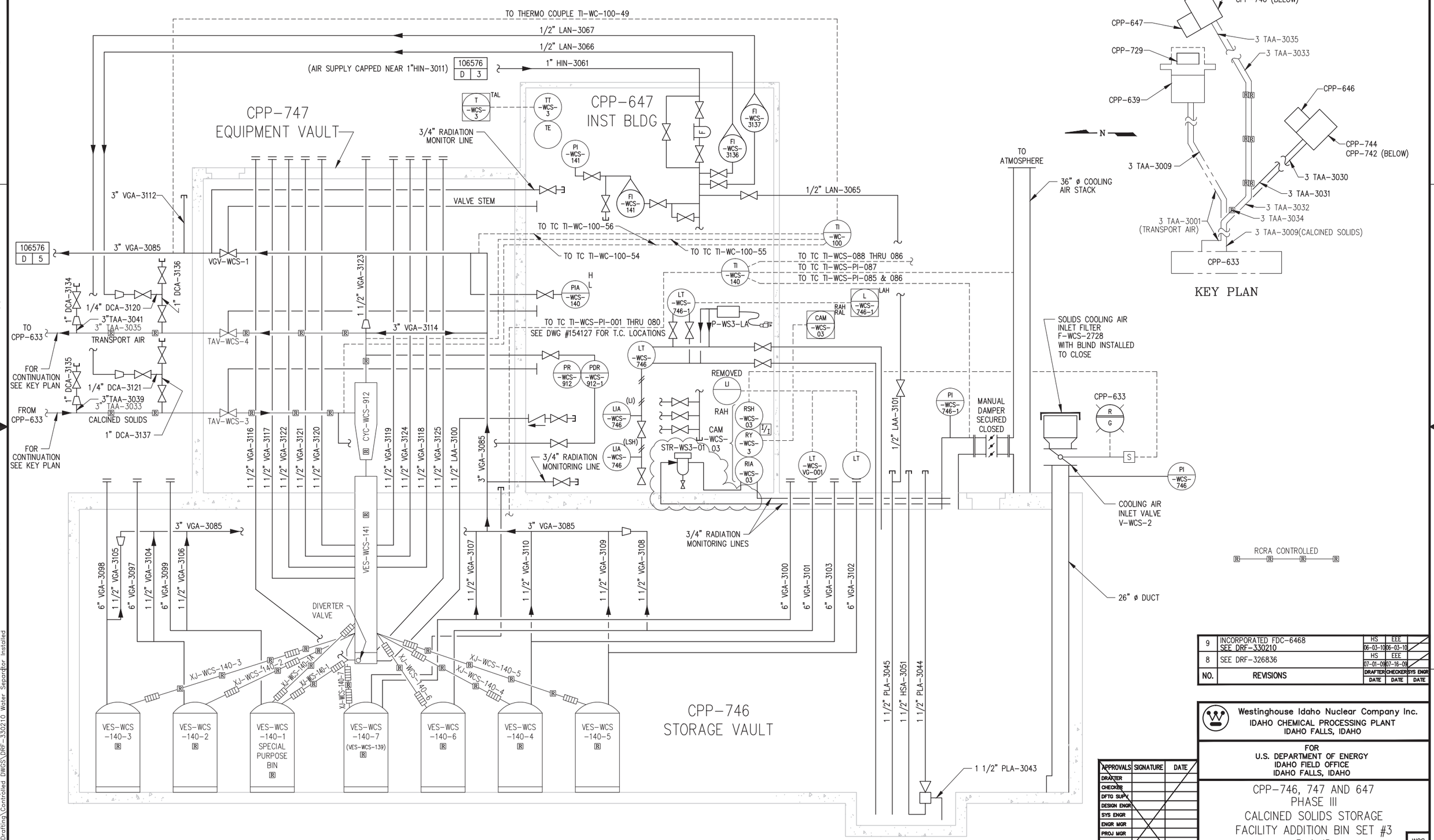
CPP-AREA
PHASE III
CALCINED SOLIDS STORAGE FACILITY ADDITION
STORAGE BINS

WCS INDEX CODE NUMBER							
AREA	DWG. TYPE	CL.	ORIG.	SERIAL			
200	07	46	53	400	153	5	10

SCALE: AS NOTED
DATE ISSUED: 10-5-70

DWG. NO. 1230-CPP-746-P-3 REV. 6

1317 PROJECT NO.



NO.	REVISIONS	DRAFTER	CHECKER	SYS ENGR
		DATE	DATE	DATE
9	INCORPORATED FDC-6468 SEE DRF-330210	HS 06-03-10	EEE 06-03-10	
8	SEE DRF-326836	HS 07-01-09	EEE 07-16-09	

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

CPP-746, 747 AND 647
PHASE III
CALCINED SOLIDS STORAGE
FACILITY ADDITION BIN SET #3
P & ID

WCS

APPROVALS	SIGNATURE	DATE
DRAFTER		
CHECKER		
DFTG SUPV		
DESIGN ENGR		
SYS ENGR		
ENGR MGR		
PROJ MGR		

SCALE NONE
DATE ISSUED

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0747	24	400	154129

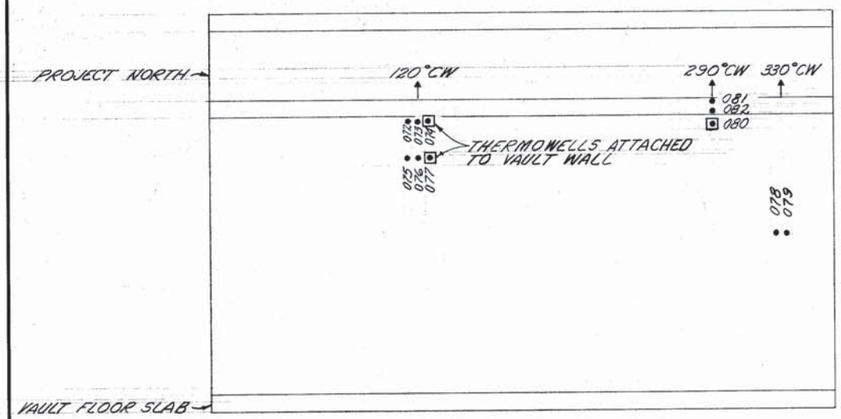
INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0647	24	400	154129

DWG. SIZE	INDEX CODE NUMBER				DRAWING NUMBER	REV.
	AREA	DWG TYPE	CL.	ORIG.		
D	200	0746	24	400	154129	9

JOB NUMBER 155754 TAKEN FROM DRAWING NO. REDRAWN

CAD GENERATED - AUTOCAD

File: 154129-9.dwg
Path: K:\INTEC Misc Drafting\Controlled DWGS\DRF-330210 Water Separator Installed
Date: 06/03/10 - 9:41 AM Layout Name: Model
By: HSPENCER



DEVELOPMENT OF VAULT CONCRETE CYLINDER

LOCATED OUTSIDE VAULT IN MECH. CONCRETE ENVELOPE SEE 1230-CPP-746-E-1

TI-WC-100-49 LOCATED ON BIN OFF GAS LINE 3" VGA 3113

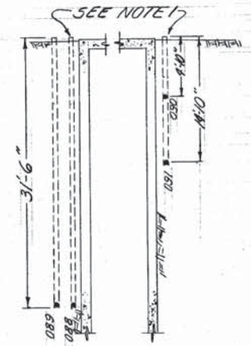
LOCATED IN EQUIP. VAULT SEE 1230-CPP-746-P-14

TI-WC-100-55 LOCATED ON CYCLONE 3" TAA 3036

TI-WC-100-56 LOCATED ON CYCLONE 3" TAA 3037

TI-WC-100-54 LOCATED ON BIN OFF GAS LINE 3" VGA 3113.

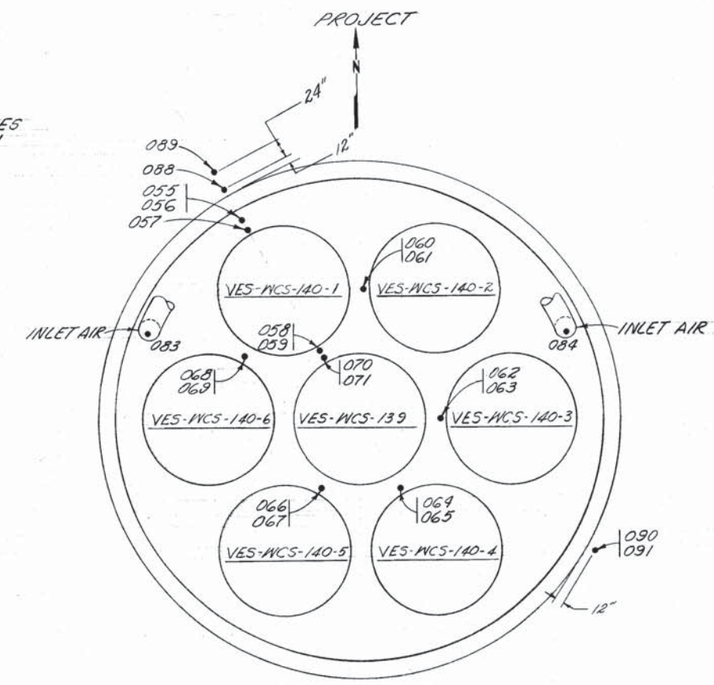
085, 086, & 087 LOCATED IN OUTLET AIR STACK SEE 1230-CPP-746-E-1, -V-1, V-2, & S-12



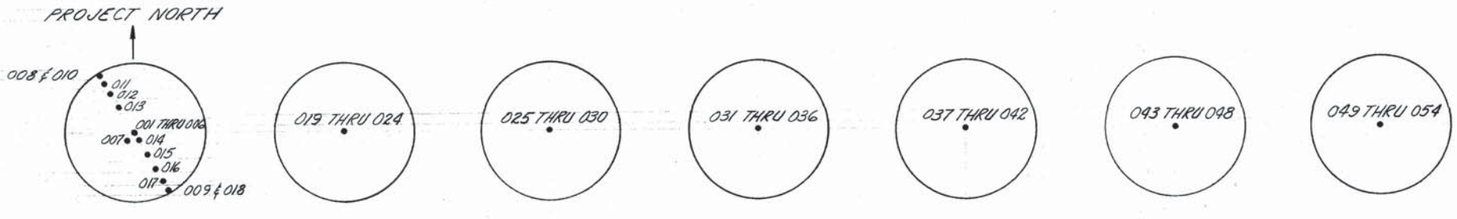
ELEVATION-THERMOCOUPLES OUTSIDE VAULT LOCATION

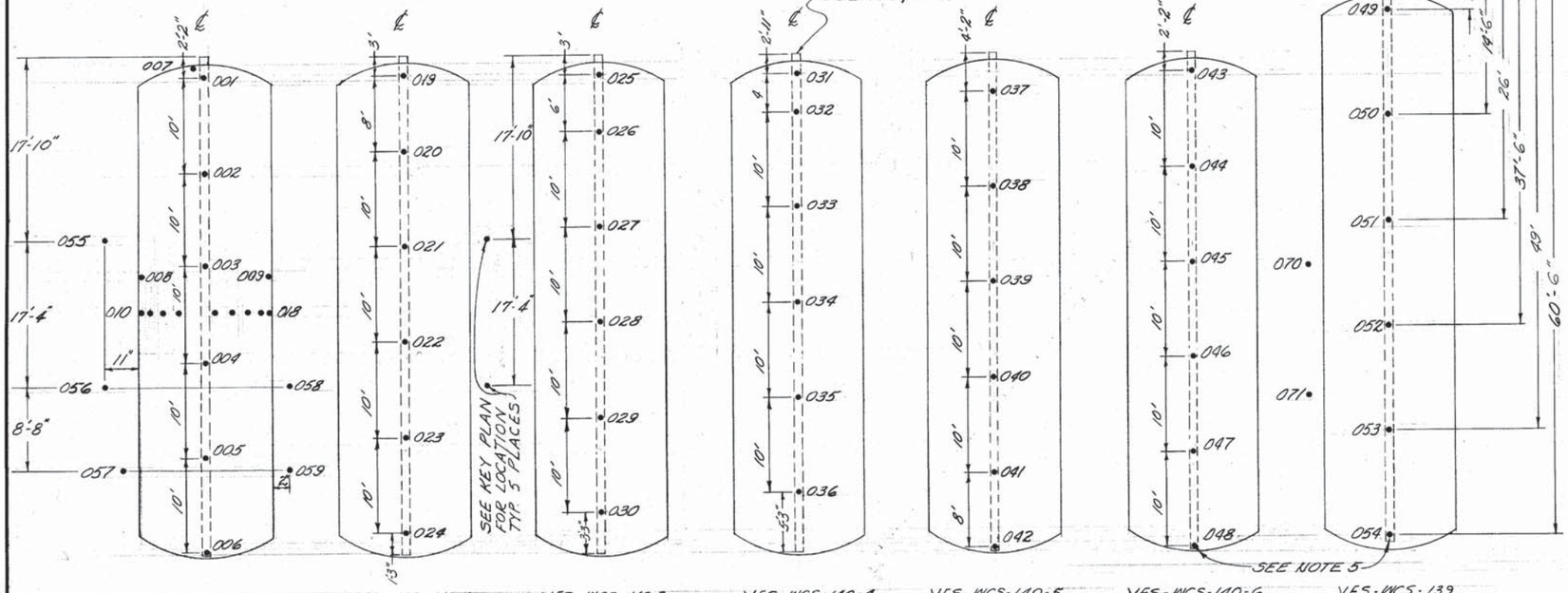
NOTES

1. MULTIPOINT THERMOCOUPLE ASSEMBLY, ALL DIMENSIONS ARE SHOWN FROM THREADED END OF THERMOWELL.
2. MULTIPOINT THERMOCOUPLES IN VERTICAL CENTER LINE OF BIN TO BE GROUP MOUNTED W/SPRING LOADED TIPS. ALL THERMOCOUPLES TO BE 1/8" OUTSIDE DIAMETER.
3. ONLY THE LAST THREE NUMBERS OF EACH THERMOCOUPLE NUMBER ARE USED. A COMPLETE THERMOCOUPLE NUMBER IS TI-WCS-PI-001, THRU -091.
4. ALL THEMOCOUPLES GOVT. FURNISHED.
5. BOTTOM THERMOCOUPLES IN VESSEL 140-1, 140-5 140-6 & 139 ARE 1" OFF THE BOTTEM OF THE THERMOWELL, OTHERS AS SHOWN.



KEY PLAN





VES-WCS-140-1 VES-WCS-140-2 VES-WCS-140-3 VES-WCS-140-4 VES-WCS-140-5 VES-WCS-140-6 VES-WCS-139

RCRA CONTROLLED DRAWING

NO.	DATE	REVISIONS	BY	APPVD. INC	APPVD. CHECK	APPVD. AEC	APPVD. AEC H&S	APPVD. AEC E&C
4	6-24-71	REVISED PER DCN # 155754-AB46	MW					
3	5-22-71	REVISED PER DCN # 155754-AB27	BJBM					
2	11-2-71	AS BUILT	GVM					
1	7-22-71	REVISED DIM. & ADDED NOTE 5.	JES					

	BY	DATE
DESIGNED	JBO	6-7-71
DRAWN	GDJ	6-28-69
CHECKED	JBO	7-28-70
APPROVED	JEL	7-31-70

APPROVALS

ORGAN.	BY	DATE
INC	GVM	7-31-70
	JEL	7-31-70
NOS	THS	8-3-70
AEC		
AEC		
AEC H&S		
AEC E&C		

IDAHO NUCLEAR CORPORATION
IDAHO FALLS, IDAHO
FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP-746

PHASE III BIN SET #3
CALCINED SOLID STORAGE FACILITY ADDITION
THERMOCOUPLE LOCATION

CONTROLLED DOCUMENT

CLASS I

WCS

INDEX CODE NUMBER

AREA	DWG TYPE	CL.	ORIG.	SERIAL
200	0746	25	400	154127

SCALE: NONE

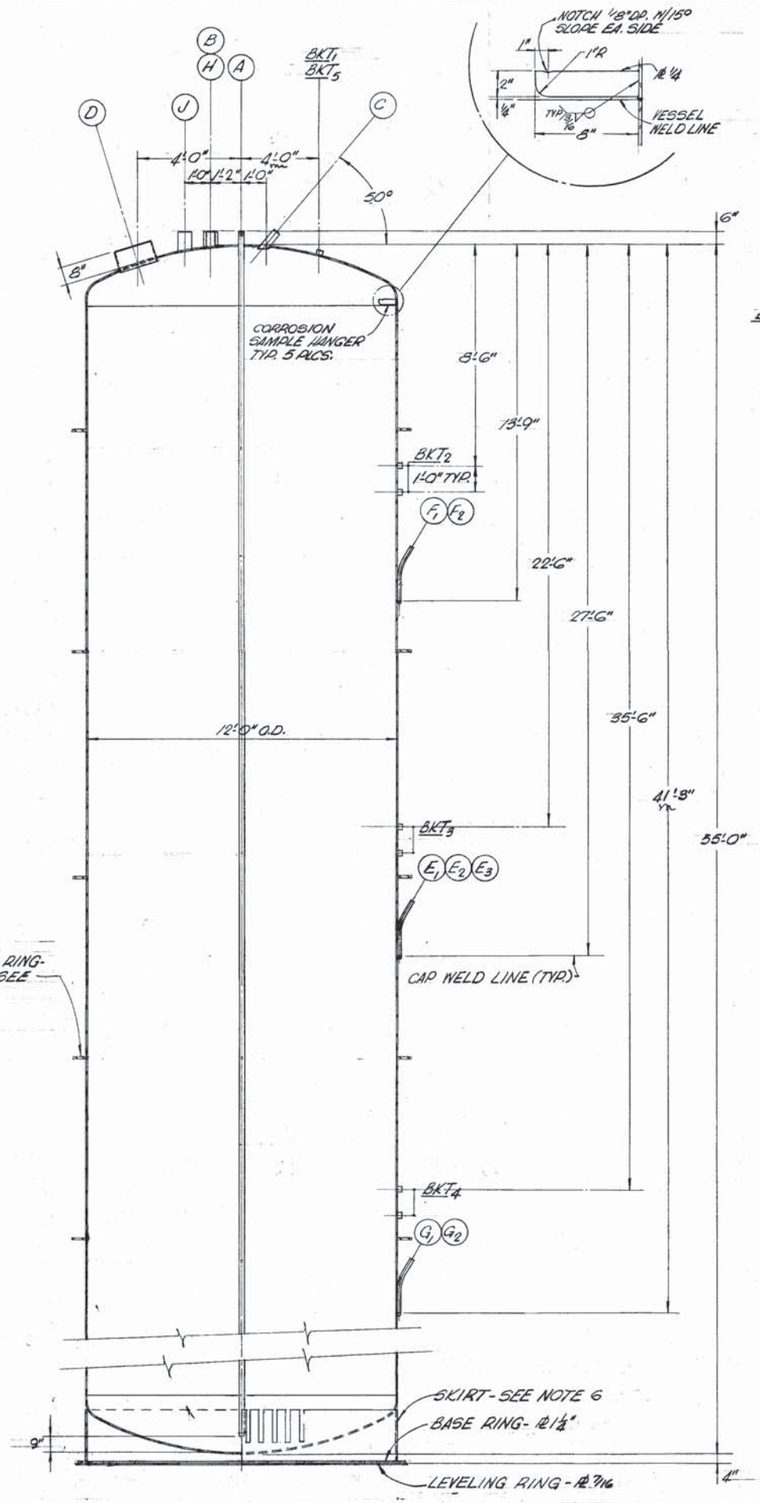
DATE ISSUED: 10-5-70

DWG. NO. 1230-CPP-746-T-3

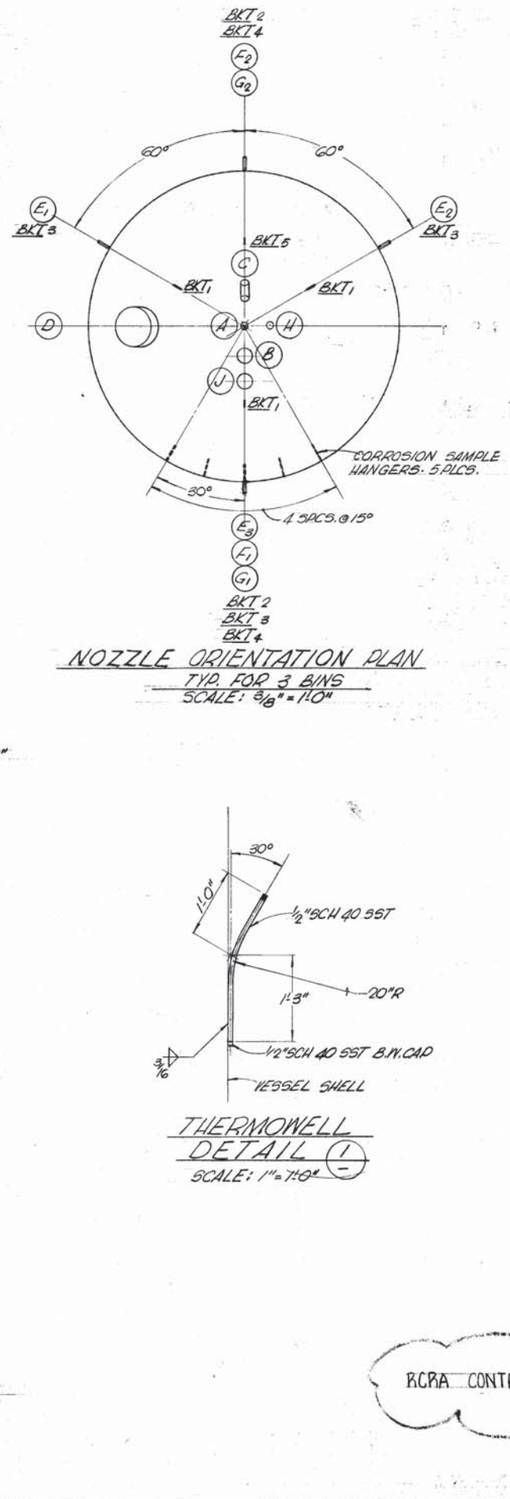
REV. 4

IDAHO NUCLEAR QUALITY ASSURANCE ESSENTIALITY LEVEL: III

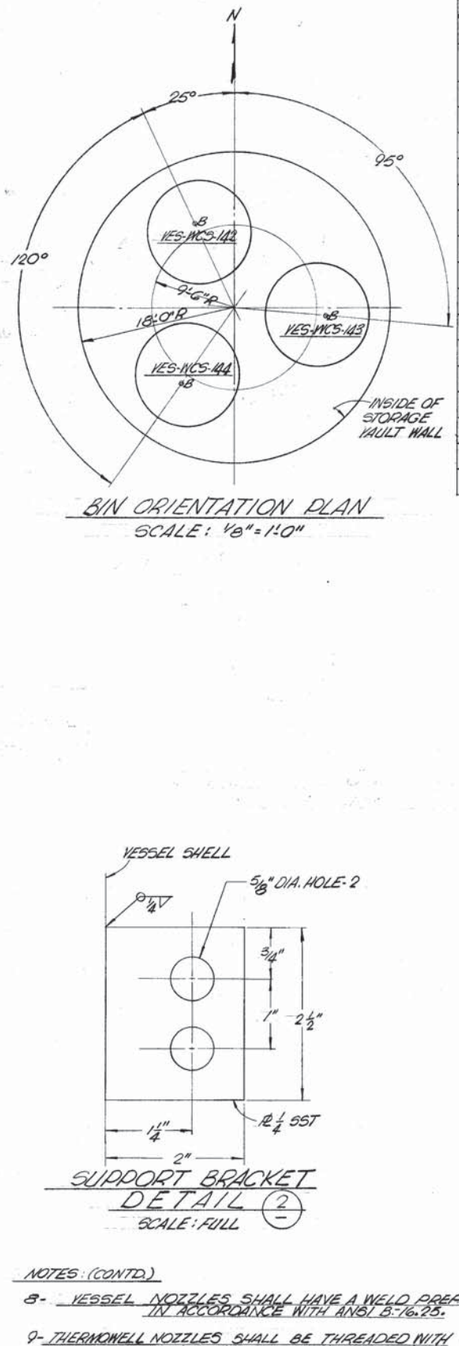
1317 K PROJECT NO.



ELEVATION
TYP. FOR 3 BINS
SCALE: 3/16" = 1'-0"



NOZZLE ORIENTATION PLAN
TYP. FOR 3 BINS
SCALE: 3/16" = 1'-0"



BIN ORIENTATION PLAN
SCALE: 1/8" = 1'-0"

FITTING SCHEDULE

MK	SERVICE	SIZE	BIN NO.	REMARKS
A	THERMOWELL	2"SCH80S	ALL BINS	SEE NOTE 4 & 9
B	SOLIDS REMOVAL	6"SCH40S	"	SEE NOTE 8
C	FILL LINE	3"SCH40S	"	SEE NOTE 8
D	MANWAY	18"STD. WT.	"	SEE NOTE 5 & 8
E_1	THERMOWELL	1/2"SCH.40S	"	SEE DETAIL 1 & NOTE 9
E_2	"	"	"	" " " " "
E_3	"	"	"	" " " " "
F_1	"	"	-142	" " " " "
F_2	"	"	"	" " " " "
G_1	"	"	"	" " " " "
G_2	"	"	"	" " " " "
BKT_1	SUPPORT BRACKET		ALL BINS	SEE DETAIL 2
BKT_2	" "			" " "
BKT_3	" "		ALL BINS	" " "
BKT_4	" "		-142	" " "
BKT_5	" "		"	" " "
H	VESSEL VENT	3"SCH.40S	ALL BINS	SEE NOTE 8
J	SOLIDS REMOVAL	6"SCH.40S	"	SEE NOTE 8

NOTES:

1- UNLESS NOTED, ALL MATL. TO BE TYPE 304 SST.

2- BIN WORKING TOLERANCES ARE AS FOLLOW: OVERALL HEIGHT ± 3/8"; MISALIGNMENT OF ℄ W/ REFERENCE TO TOP ≠ BOTTOM ± 1/16"; NOZZLE LOCATION ± 1/4".

3- THE BIN SUBCONTRACTOR SHALL DETERMINE VESSEL SHELL & HEAD THICKNESS & PROVIDE NECESSARY RIDE GUIDES & VESSEL STABILIZING COMPONENTS.

4- MISALIGNMENT OF NZL. 'A' FROM VESSEL ℄ : ± 1/4"

5- BIN SUBCONTRACTOR TO FURNISH MATING HEAD FOR NZL. 'D' (WELD CAP) FOR FIELD INSTALLATION BY GTAW WELDING.

6- SKIRT TO PROVIDE APPROX. 20% OPEN AREA FOR VENTILATION.

7- ANCHORAGE FOR ANCHOR BOLTS CONSISTS OF A 4'-6" THICK REINFORCED CONCRETE SLAB OF 4000 PSI CONCRETE. THICKNESS OF SLAB MAY BE INCREASED IF NECESSARY.

THERMOWELL DETAIL (1)
SCALE: 1" = 1'-0"

SUPPORT BRACKET DETAIL (2)
SCALE: FULL

NOTES: (CONTD.)

8- VESSEL NOZZLES SHALL HAVE A WELD PREP IN ACCORDANCE WITH ANSI B:16.25.

9- THERMOWELL NOZZLES SHALL BE THREADED WITH A NATIONAL PIPE THREAD (NPT).

RCRA CONTROLLED DRAWING

Jerry E. Langford P.E. # 2681

CONTROLLED CLASS 1 DOCUMENT

NO.	DATE	REVISIONS	APPVD. ENG	APPVD.	APPVD.	APPVD. AEC	APPVD. AEC H&S	APPVD. AEC E&C
5	6-24-76	REVISED PER DCN #55754-A847 AW	[illegible]	JW	DRB			
4	10-20-75	SEE DCN # 4 KWG	[illegible]	JW	DRB			
3	10-28-75	AS BUILT DRB	[illegible]	KWH	KWH			
2	9-29-75	CHANGED STIFFENER RINGS TO EXTERIOR	DRH	DRB				
1	9-29-75	CHANGED BIN HT. & NZL. LOC. TOLERANCES	DRH	DRB				

	BY	DATE
DESIGNED	L. Tom	6-20-75
DRAWN	Wmann	10-27-75
CHECKED	JPB	6-28-75
APPROVED	RKH	8-29-75

APPROVALS

ORGAN.	BY	DATE
INC		
ACC	D&B	8-29-75
AEC		
AEC		
AEC H&S		
AEC E&C		

AEROJET NUCLEAR COMPANY
INCORPORATED
IDAHO FALLS, IDAHO
FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP AREA

CALCINED SOLIDS STORAGE FACILITY FOURTH ADDITION STORAGE BINS

MCS

INDEX CODE NUMBER

AREA	DWG. TYPE	CL.	ORIG.	SERIAL
200	0760	5	3	400155750

SCALE: NOTED

DATE ISSUED: 8-29-75

DWG. NO. 1375-CPP-760-M-1

REV. 5

PROJECT NO.

CPP-658
INSTRUMENT
BUILDING

CYCLONE
VAULT

CPP-761
VENTILATION
EQUIPMENT
VAULT

CPP-760
STORAGE
VAULT

CPP-761
VENTILATION
EQUIPMENT
VAULT
(IN VENT EQUIP. VAULT)

ROD-OUT LINES (CLEAN-OUT)

1" HAN-101434
2" HSN-101435
3/4" CTN-101437
TO MANHOLE
1/2" LAN-101440
1/2" LAN-101442
1/2" LAN-101466
1/2" LAN-101467
1/2" LAN-101464
1/2" LAN-101465
1/2" LAN-101453
1" LAN-101434
1" DCA-101441
1" DCA-101443
1/2" LAA-101466
1 1/2" HSA-101436
1 1/2" HSN-101436
3" TAA-101438
1 1/2" HSA-101439
1 1/2" HSA-101440
1/2" LAA-101467
1 1/2" HSA-101468
1/2" LAA-101464
3" VGA-101471
3" VGA-101468
3" VGA-101444
3" VGA-101469
3" VGA-101462
3" VGA-101461
3" VGA-101457
2" VGA-101463
2" VGA-110250
2" VGA-101462
2" VGA-101461
2" VGA-101468
2" VGA-101458
2" VGA-101459
2" VGA-101460
3" VGA-101446
6" VGA-101447
6" VGA-101448
6" VGA-101449
6" VGA-101450
6" VGA-101451
6" VGA-101452
1 1/2" PLA-101454
1 1/2" HSA-101455
1 1/2" PLA-101456
6" VGA-101447
6" VGA-101448
6" VGA-101449
6" VGA-101450
6" VGA-101451
6" VGA-101452
3" VGA-101445
3" VGA-101444
1" LAN-101434
1" HAN-101434
1" WCS-HA-11
3/4" RAD. MONITOR LINE
3/4" RAD. MONITOR LINE
3/4" RADIATION MONITOR LINES
1/4"
1/2"
3/4"
36" ø COOLING AIR STACK
COOLING AIR DUCT
COOLING AIR OUTLET DAMPER
COOLING AIR INLET DAMPER
MANUAL DAMPER SECURED CLOSED
STORAGE VAULT ACCESS HATCH
CYCLONE VAULT ACCESS HATCH
HANDLES
HANDLE
14" ENCASEMENT
1" ENCASEMENT SAMPLE
(STEAM TRACE)
VAULT HEATER
VIBRATOR
CYCLONE
DIVERTER VALVE
VES-WS4-145
DISTRIBUTOR PIPE
FROM TE1-1 THRU 1-57 SEE DWG 157814
ROD-OUT FOR VES-WS4-143
ROD-OUT FOR VES-WS4-142
ROD-OUT FOR VES-WS4-144
XJ-WS4-143
XJ-WS4-142
XJ-WS4-144
SOLIDS COOLING AIR INLET FILTER WITH BLIND INSTALLED TO CLOSE
COOLING AIR DUCT
RCRA CONTROLLED

DCV-WS4-1
DCV-WS4-2
DCV-WS4-3
DCV-WS4-4
DCV-WS4-5
DCV-WS4-6
SGV-WS4-20
TAV-WS4-1
TAV-WS4-2
VGV-WS4-1
PSV-WS4-10 (SET AT 3 PSI)
PSV-WS4-9 (SET AT 2 PSI)
PSV-WS4-8 SET AT (-3) PSI
F-WS4-101
F-WS4-102
F-WS4-103
F-WS4-100
CYC-WS4-916
VES-WS4-143
VES-WS4-142
VES-WS4-144
STR-WS4-601
STR-WS4-602
STR-WS4-603
HSV-WS4-1
HSV-WS4-2
HSV-WS4-3
HSV-WS4-4
HSV-WS4-5
HSV-WS4-61
HSV-WS4-40
HSV-WS4-41
XCV-WS4-38
HAV-WS4-12
PCV-WS4-3
LAV-WS4-1 thru LAV-WS4-27
PIV-WS4-143-1
PIV-WS4-142-1
PIV-WS4-144-1
PDTV-WS4-1-1
PDTV-WS4-1-2
PDTV-WS4-1-3
PDTV-WS4-1-4
SGV-WS4-23
SGV-WS4-24
PDT-WS4-1-2
PDT-WS4-1-3
PT-WS4-1-1
PDR-WCS-1
PR-WCS-1
TE-WS4-1-58
TE-WS4-1-59 & TE-WS4-1-60
JET-WS4-500
CAM-WS4-01
RA-WS4-01
RR-WS4-01
RSH-WS4-01
RIA-WS4-01
LA-WS4-1
LI-WS4-1
ZS
M
R
G

20	AS-BUILT AS OF 10-26-04 SEE DAR 116593	DEJ	DEJ		
		11-3-04	11-4-04		
19	AS-BUILT AS OF 7/21/04 SEE DAR 111356	VKJ	DEJ		
		7/21/04	7/28/04		
NO.	REVISIONS	DRAFTER DATE	CHECKER DATE	DFTG SUPV DATE	SYS ENGR DATE

NOTE:
1. CALCINER PROCESS CLOSURE BOUNDARY VALVE SECURED CLOSED.
2. CALCINER SYSTEM CLOSURE BOUNDARY (DOE/ID-10801).

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

CPP-760, 761 & 658
CALCINED SOLIDS STORAGE FACILITY
BIN SET # 4
P & ID

WS4

APPROVALS	SIGNATURE	DATE
DRAFTER		
CHECKER		
DFTG SUPV		
DESIGN ENGR		
SYS ENGR		
ENGR MGR		
PROJ MGR		

SCALE NONE
DATE ISSUED

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0658	24	400	157798

INDEX CODE NUMBER				
AREA	DWG TYPE	CL	ORIG.	SERIAL
200	0761	24	400	157798

DWG. SIZE	INDEX CODE NUMBER				DRAWING NUMBER	REV.
	AREA	DWG TYPE	CL	ORIG.		
D	200	0760	24	400	157798	20

JOB NUMBER 155754 TAKEN FROM DRAWING NO. REDRAWN

CAD GENERATED - AUTOCAD

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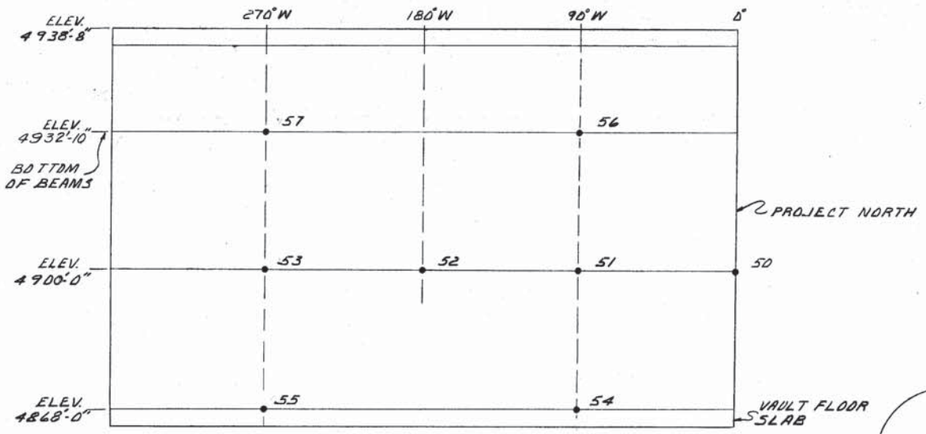
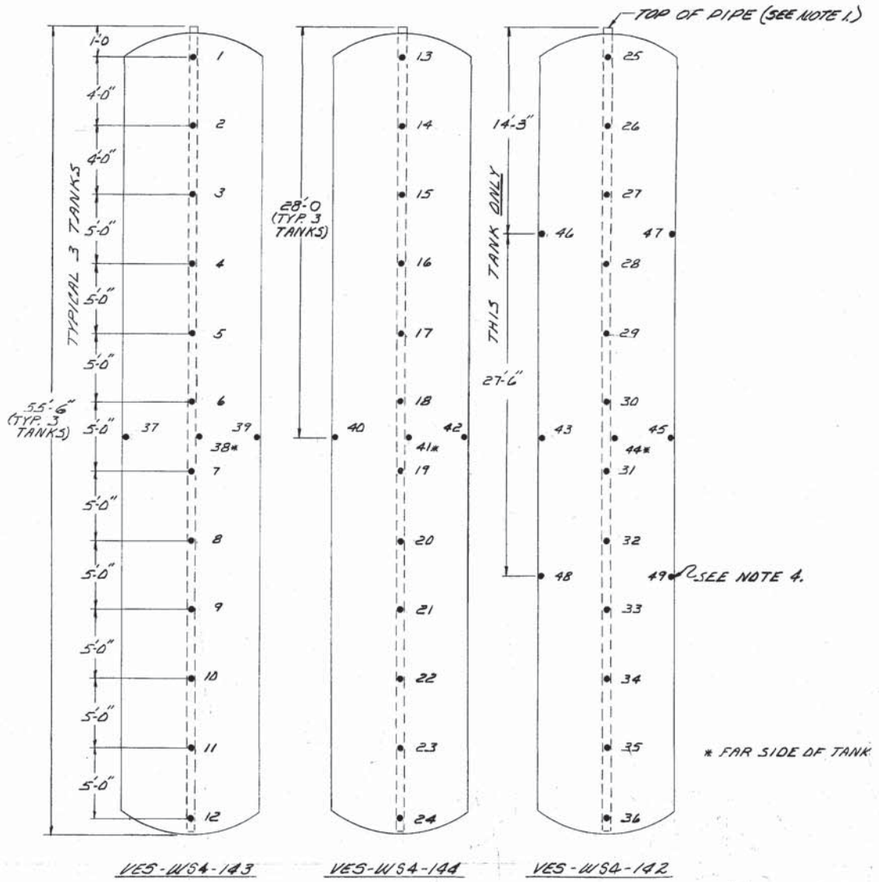
Path: P:\Tiffs Date: 11/03/04 - 09:03 A.M.



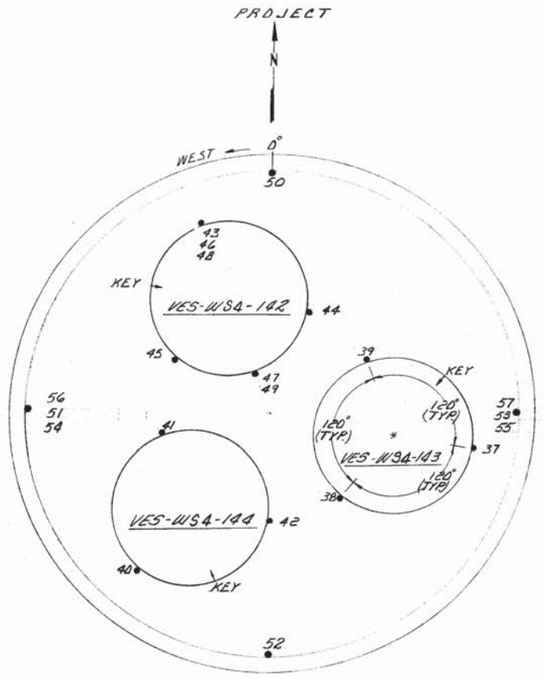
DEVELOPMENT OF VAULT CONCRETE CYLINDER





NOTES

1. ALL DIMENSIONS ARE SHOWN TO THERMOCOUPLE TIP
2. MULTIPOINT THERMOCOUPLES IN VERTICAL CENTER LINE OF BIN GROUP MOUNTED W/SPRING LOADED TIPS. ALL THERMOCOUPLES TO BE 1/8" OUTSIDE DIAMETER.
3. ONLY THE LAST TWO DIGITS OF EACH THERMOCOUPLE NUMBER ARE USED. A COMPLETE THERMOCOUPLE NUMBER IS TE-WS4-1-1 THRU 1-57.
4. SEE "KEY PLAN" FOR LOCATION OF ALL EXTERNAL BIN THERMOCOUPLES.



KEY PLAN

RCRA CONTROLLED DRAWING

CONTROLLED CLASS 1 DOCUMENT

NO.	DATE	REVISIONS	BY	DATE	APPVD. RHC	APPVD.	APPVD. AEC	APPVD. AEC	APPVD. AEC
5	6-21-79	REVISED PER DCN # 155754-AB48	MW	6-21-79					
4	6-13-79	REVISED PER DCN # 155754-AB30	DWBM	6-13-79					
3	5-21-79	SEE DCN 83-003	MJB	5-21-79					
2	3-19-79	AS BUILT	ENM	3-19-79					
1	12-7-76	CHANGED T.C. DIM. (SEE ECR #)	GDJ	12-7-76					

	BY	DATE
DESIGNED	JPB	9-1-76
DRAWN	T. WADDS	9-24-76
CHECKED	JPB	11-7-75
APPROVED	RRH	11-7-75

APPROVALS ORGAN.	BY	DATE
INC		
ACC	O.K.B.	11-11-75
AEC		
AEC		
AEC H&S		
AEC E&C		

AEROJET NUCLEAR COMPANY
INCORPORATED
IDAHO FALLS, IDAHO
FOR
U. S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP-760 BIU SET #4

CALCINED SOLIDS STORAGE FACILITY FOURTH ADDITION

THERMOCOUPLE LOCATION

INDEX CODE NUMBER					
AREA	DWG. TYPE	CL.	ORIG.	SERIAL	
200	760	10	400	157814	

WS4

SCALE: NONE

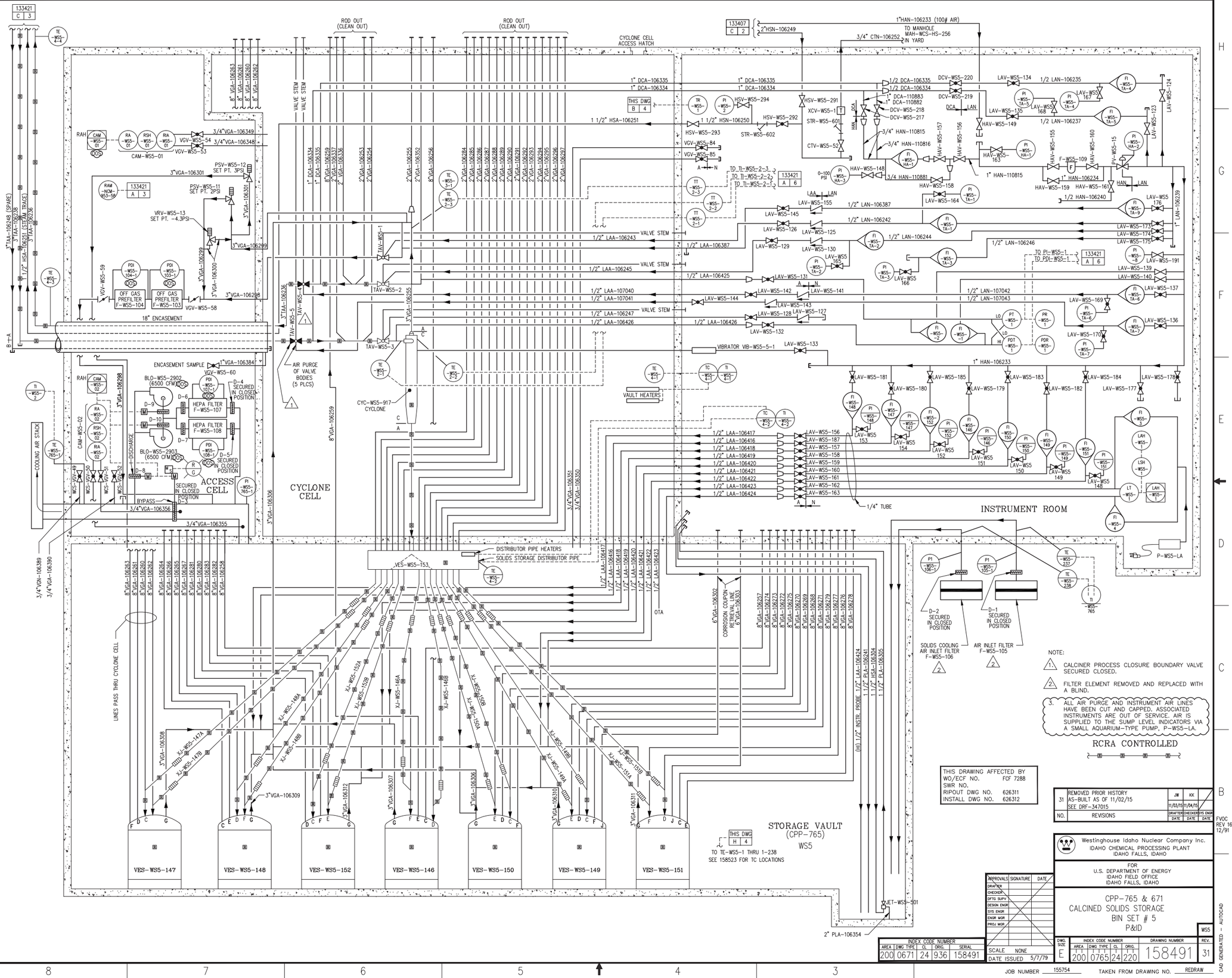
DATE ISSUED: 1-14-76

DWG. NO. 1375-CPP-760-T-3

REV. 5

E-(18-11)-1548

PROJECT NO.


CYCLONE CELL
ACCESS CELL
INSTRUMENT ROOM
STORAGE VAULT (CPP-765) WS5
VES-WS5-147
VES-WS5-148
VES-WS5-152
VES-WS5-146
VES-WS5-150
VES-WS5-149
VES-WS5-151
ROD OUT (CLEAN OUT)
CYCLONE CELL ACCESS HATCH
VALVE STEM
AIR PURGE OF VALVE BODIES (5 PLCS)
VAULT HEATERS
DISTRIBUTOR PIPE HEATERS
SOLIDS STORAGE DISTRIBUTOR PIPE
LINES PASS THRU CYCLONE CELL
CORROSION COUPON RETRIEVAL LINE
18" ENCASEMENT
ENCASEMENT SAMPLE
COOLING AIR STACK
BYPASS
SOLIDS COOLING AIR INLET FILTER F-WS5-106
AIR INLET FILTER F-WS5-105
TO MANHOLE MAH-WCS-HS-256
3/4" CTN-106252 IN YARD
1" HAN-106233 (100# AIR)
2" HSN-106249
1 1/2" HSN-106250
1 1/2" HSA-106251
1" HAN-110815
1" HAN-106234
1/2 HAN-106240
1" LAN-106239
1/2" LAN-106387
1/2" LAN-106242
1/2" LAN-106244
1/2" LAN-106246
1/2" LAA-106243
1/2" LAA-106245
1/2" LAA-106425
1/2" LAA-107040
1/2" LAA-107041
1/2" LAA-106247
1/2" LAA-106426
1/2" LAA-107042
1/2" LAA-107043
1/4" TUBE
JET-WS5-501
2" PLA-106354
(4) 1/2" INSTR. PROBE 1/2" LAA-106424
1 1/2" PLA-106241
1 1/2" HSA-106304
1 1/2" PLA-106305
OTA
P-WS5-LA
TO TE-WS5-1 THRU 1-238
SEE 158523 FOR TC LOCATIONS
NOTE:
1. CALCINER PROCESS CLOSURE BOUNDARY VALVE SECURED CLOSED.
2. FILTER ELEMENT REMOVED AND REPLACED WITH A BLIND.
3. ALL AIR PURGE AND INSTRUMENT AIR LINES HAVE BEEN CUT AND CAPPED. ASSOCIATED INSTRUMENTS ARE OUT OF SERVICE. AIR IS SUPPLIED TO THE SUMP LEVEL INDICATORS VIA A SMALL AQUARIUM-TYPE PUMP, P-WS5-LA.
RCRA CONTROLLED
THIS DRAWING AFFECTED BY
WO/ECF NO. FCF 7288
SWR NO.
RIPOUT DWG NO. 626311
INSTALL DWG NO. 626312
31 REMOVED PRIOR HISTORY AS-BUILT AS OF 11/02/15 SEE DRF-347015 JW KK 11/03/15 11/04/15
NO. REVISIONS DRAFTER DATE CHECKER DATE DYS ENGR DATE
FVOC REV 16 12/91
Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO
FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO
CPP-765 & 671
CALCINED SOLIDS STORAGE
BIN SET # 5
P&ID
WS5
APPROVALS SIGNATURE DATE
DRAFTER
CHECKER
DFTG SUPV
DESIGN ENGR
SYS ENGR
ENGR MGR
PROJ MGR
SCALE NONE
DATE ISSUED 5/7/79
INDEX CODE NUMBER AREA 200 DWG TYPE 0671 CL 24 ORIG. 936 SERIAL 158491
DWG. SIZE E
INDEX CODE NUMBER AREA 200 DWG TYPE 0765 CL 24 ORIG. 220
DRAWING NUMBER 158491
REV. 31
JOB NUMBER 155754
TAKEN FROM DRAWING NO. REDRAW
CAD GENERATED - AUTOCAD
ID: WILLIT
Date: 11/03/15 - 1:16 PM Layout: Model
Path: K:\CI-Sprof\Checker Review\Work\CPP-765\347015 Submitted to DMS

LIFTING LUG, 2 REQ'D 180° APART SEE DET (4)

FOR INDIVIDUAL NOZZLE ORIENTATION SEE PLAN FOR EACH BIN SHOWN ON DWG. 158511 & 158512 (VES-WS5-146 THRU 152)

SEE DETAIL (2) TYP ALL SUPPORT BRACKETS

NOTCH 1/8" DP W/15° SLOPE EA SIDE

VESSEL WELD LINE

CORROSION SAMPLE HANGER TYP 5 PLC'S VESSELS 149 & 151

SEE DETAIL (1) TYP. ALL THERMOWELLS

(NOTE: FOR THERMOWELLS REQ'D ON EACH BIN SEE INDIVIDUAL BIN REQUIREMENTS ON ORIENTATION PLANS ON DWG'S 158511 & 158512)

EXTERIOR STIFFENER RING AS REQ'D - SEE NOTE 3

ANNULUS STIFFENER SEE NOTE 3

EXTERIOR SHELL SEE NOTE 3

ANNULUS SHELL SEE NOTE 3

SKIRT - SEE NOTE 6 (W/ APPROX. 20% OPEN AREA FOR VENT.)

BASE PL LEVELING RING

VAULT FLOOR

ANCHOR BOLTS AS REQ'D

2" (±) GROUT

EL. 4868'-2"

55'-0"

50'-0"

14'-5"

12'-9" TYP.

1'-6" TYP.

2'-4"

8"

6"

BKT 1

BKT 2

BKT 3

BKT 4

BKT 5

BKT 6

BKT 7

BKT 8

BKT 9

BKT 10

BKT 11

BKT 12

F4 F1 F3 F2 E4 E1 E3 E2 G3 G2 G1

DETAIL (3) 490

2'-6" MIN I.D. TYP

4'-0" O.D.

12'-0" OD.

13'-9"

13'-9"

2'-4"

2'-8"

15"

SECTION (A) 158511 & 158512

SCALE: 3/8"=1'-0"

(TYP. ALL BINS EXCEPT AS NOTED)

N

60° (6 PLACES)

14'-6" RAD.

23'-6"

VES-WS5-150

VES-WS5-151

VES-WS5-149

VES-WS5-146

VES-WS5-152

VES-WS5-148

VES-WS5-147

INSIDE OF STORAGE VAULT WALL

BIN ORIENTATION PLAN

SCALE: 1/8"=1'-0"

VESSEL SHELL

5/8" DIA THRU 2 PLACES

1/4"

3 1/4"

1"

2 1/2"

1 1/4"

2"

R 1/4 SST

SUPPORT BRACKET DETAIL (2)

SCALE: FULL

1/2"Ø

9/16"Ø

2 1/2"

1"

1/4"

3/4"

1 1/2"

1/2"

7"

BRACKET EXTENSION

SCALE: 1/2" = 1"

1 1/4" R

2" DIA THRU

FULL RADIUS

30°

1'-10"

3'-0"

1'-10"

1'-3"

1/2" SCH 40 SST PIPE

20" R

CAP - 1/2" SCH. 40 SST. B.W.

VESSEL SHELL

THERMOWELL DETAIL (1)

SCALE: NONE

1 1/4" R

1'-6"

20"

TAN HEAD

VESSEL

LIFTING LUG - 2 REQ'D DETAIL (4)

SCALE: 1 1/8"=1'-0"

THIS DWG. ONLY FOR INFO. WHICH MAY BE REQ'D FOR THE INSTALLATION OF THE SEVEN STORAGE BINS FURN. TO THE CONTRACTOR BY THE GOV'T. WORK SHOWN ON THIS DWG. IS FOR INFO. ONLY APPROXIMATE WEIGHT FOR EACH BIN IS 65,000 LBS

RCRA CONTROLLED DRAWING

0' 1' 2' 3' 4'

SCALE 1"=1'-0"

0' 5' 10'

SCALE 3/8"=1'-0"

FITTING SCHEDULE

MK	SERVICE	SIZE	BIN NO.	REMARKS
A	THERMOWELL	2" SCH. 80S	146-152	SEE NOTES 4 & 9
B	THERMOWELL	2" SCH. 80S	146-152	SEE NOTES 4 & 9
C	RETRIEVAL	8" SCH 40S	146-152	SEE NOTE 8
D	RETRIEVAL	8" SCH 40S	146-152	SEE NOTE 8
E	RETRIEVAL	8" SCH 40S	146-152	SEE NOTE 8
F	RETRIEVAL	8" SCH 40S	146-152	SEE NOTE 8
G	VENT	8" SCH 40S	146-152	SEE NOTE 8
H	MANWAY	18" STD. WT.	146-152	SEE NOTES 5 & 8
J	COUPON SAMP.	6" SCH. 40S	149, 151	SEE NOTE 8
E1	THERMOWELL	1/2" SCH. 40S	ALL BINS	SEE DETAIL 1 & NOTE 9
E2	"	"	"	"
E3	"	"	"	"
E4	"	"	"	"
F1	"	"	"	"
F2	"	"	"	"
F3	"	"	ALL BINS	"
F4	"	"	146	"
G1	"	"	147-152	"
G2	"	"	ALL BINS	"
G3	THERMOWELL	1/2" SCH. 40S	ALL BINS	SEE DETAIL 1 & NOTE 9
BKT-1 THRU BKT-12	SUPPORT BRACKET	DETAIL 2 THIS DWG.	PER EA BIN PLAN	LOCATE EACH BKT AS REQ'D ON PLANS DWGS. 158511 & 158512

GENERAL NOTES

1. UNLESS NOTED, ALL MAT'L TO BE TYPE 304L SST.
2. BIN WORKING TOLERANCES ARE AS FOLLOWS: OVERALL HEIGHT ± 3/4"; MISALIGNMENT OF ℄ W/REFERENCE TO TOP & BOTTOM ± 1/2"; NOZZLE LOCATION ± 1/4"; BASE LEVELING RING, BASE PLATE AND ANCHOR BOLT HOLES ± 1/8".
3. THE BIN SUBCONTRACTOR SHALL DETERMINE VESSEL SHELL & HEAD THICKNESS & PROVIDE NECESSARY PIPE GUIDES & VESSEL STABILIZING COMPONENTS.
4. MISALIGNMENT OF NZL "A" & "B" FROM VESSEL ℄: ± 1/4"
5. BIN SUBCONTRACTOR TO FURNISH MATING HEAD FOR NZL'D (WELD CAP) FOR FIELD INSTALLATION BY GTAW WELDING.
6. SKIRT TO PROVIDE APPROX. 20% OPEN AREA FOR VENTILATION.
7. ANCHORAGE FOR ANCHOR BOLTS CONSISTS OF A 5'-0" THICK REINFORCED CONCRETE SLAB OF 4000 PSI CONCRETE.
8. VESSEL NOZZLES SHALL HAVE A WELD PREP. IN ACCORDANCE WITH ANSI B-16.25.
9. THERMOWELL NOZZLES SHALL BE THREADED WITH A NATIONAL PIPE THREAD (NPT).
10. SUPPORTS FOR NOZZLES A & B SHALL NOT INTERFERE WITH LINE OF SIGHT THRU RETRIEVAL NOZZLES C, D, E OR F.
11. 6"&8" NOZZLE SCHEDULES SHOWN ARE MINIMUMS. THE BIN SUBCONTRACTOR SHALL DETERMINE SCHEDULE IN HIS DESIGN.

CONTROLLED DOCUMENT CLASS 1

NO	DATE	REVISIONS	APPVD.	APPVD.	APPVD. ACC	APPVD. DOE-ID	APPVD. DOE-ID
3	6-28-79	REVISED PER DCN # 155754-AB41	MWK				
2	2-1-79	SEE DCN # 2 83-269 JWR	JWR				
1	12-21-78	AS-BUILT	TWT				

	BY	DATE
DESIGNED	CRL	1/1877
DRAWN	CRL	1/1877
CHECKED	JPG	2-3-78
APPROVED	JEL	2-3-78

APPROVALS

ORGAN.	BY	DATE
EG&G		
ACC.	MWK	2-3-79
DOE-ID		
DOE-ID		
" H&S		
" E&C		

EG&G Idaho, Inc.

FOR U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION IDAHO OPERATIONS OFFICE IDAHO FALLS, IDAHO

CPP AREA

6TH SET CALCINE SOLIDS STORAGE BINS

BINS SECTION, DETAILS & BIN ORIENTATION PLAN

WS5

INDEX CODE NUMBER

AREA	DWG. TYPE	CL	ORIG.	SERIAL
200	076	5	6	220 1 585 0

SCALE AS SHOWN

DATE ISSUED 5-7-79

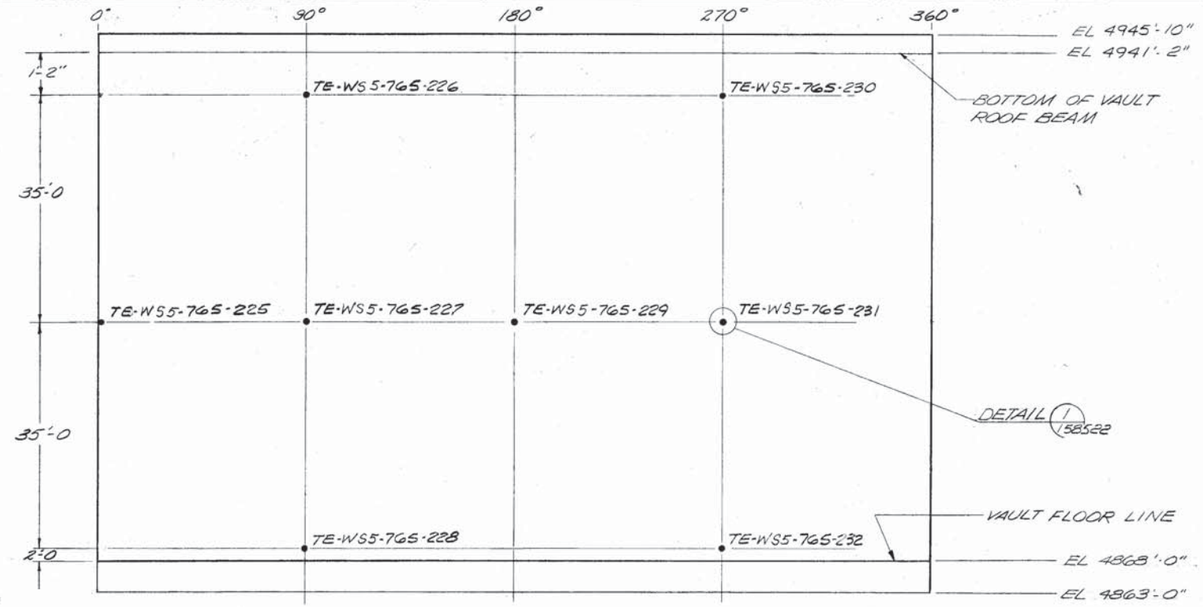
DWG. NO. 158510

REV 3

PROJECT NO.

ALLIED CHEMICAL QUALITY ASSURANCE ESSENTIALITY LEVEL: B

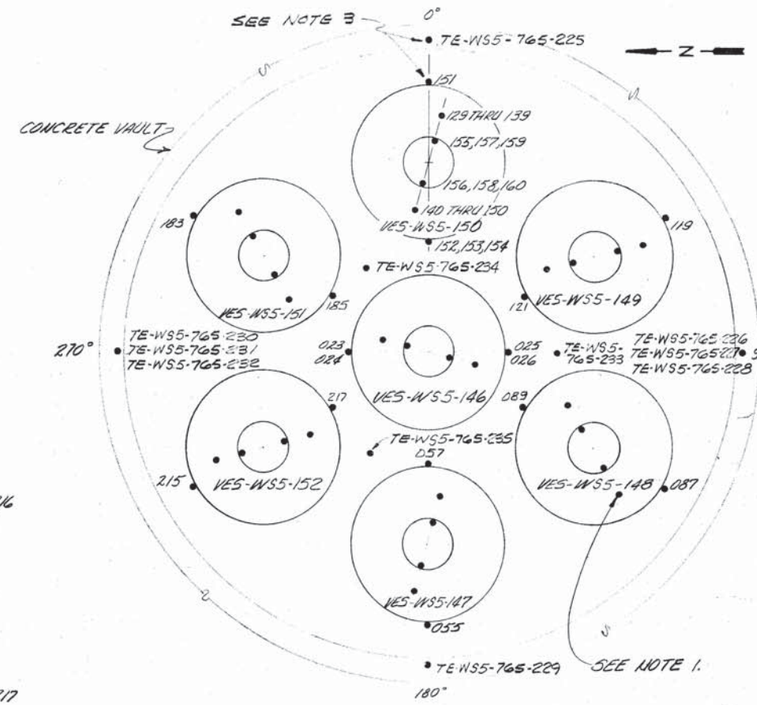
OIS&CL



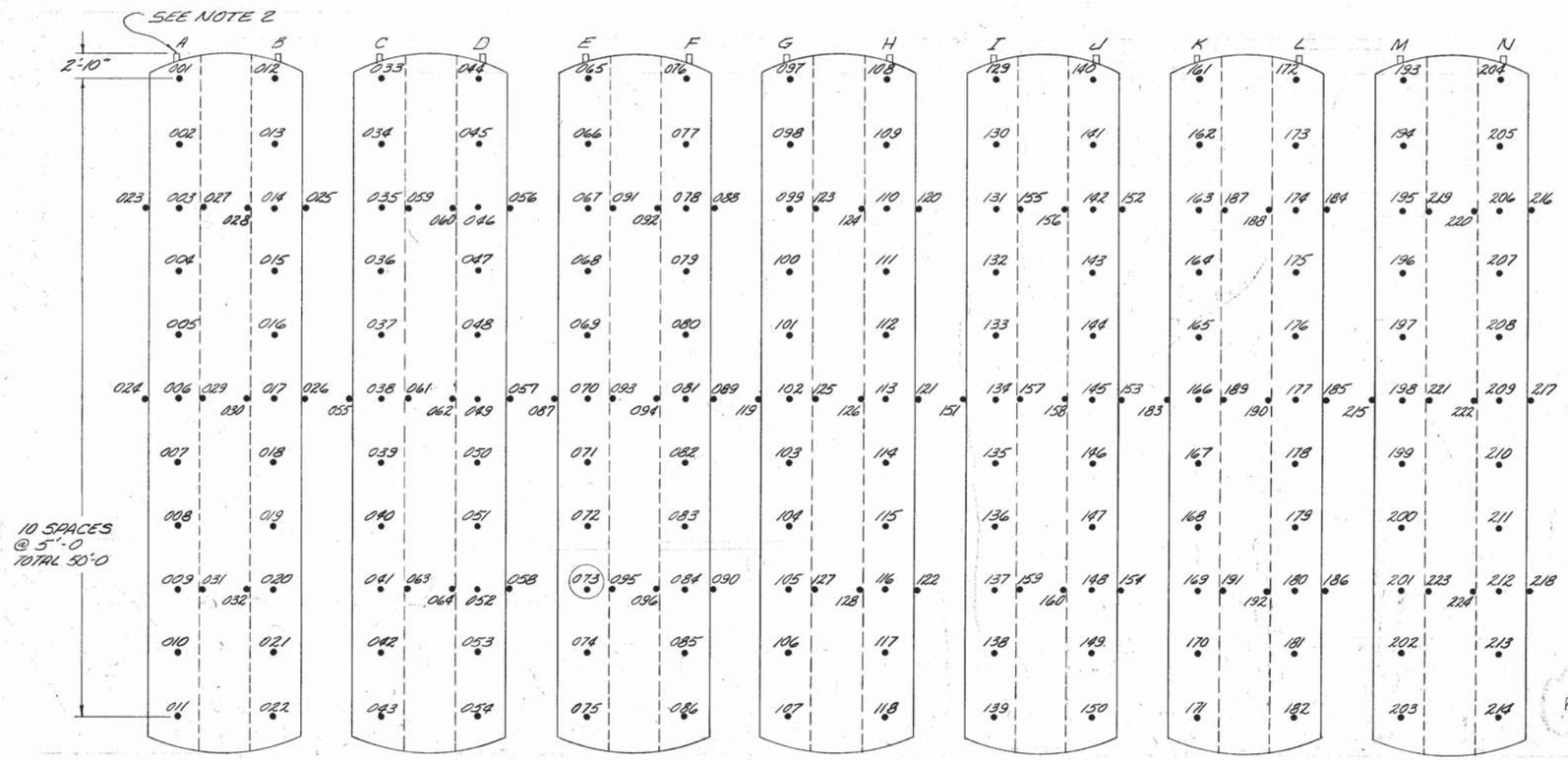
DEVELOPMENT OF VAULT CONCRETE CYLINDER

NOTES:

1. FOR THERMOCOUPLE NUMBERS SEE TANK ELEVATIONS
2. MULTIPOINT THERMOCOUPLE ASSEMBLY DIMENSIONS ARE SHOWN FROM THREADED END OF THERMOWELL
3. ONLY THE LAST THREE NUMBERS OF EACH TE ON EACH BIN ARE SHOWN. COMPLETE NUMBERS ARE: TE-WS5-146-001 THRU TE-WS5-146-032, TE-WS5-147-033 THRU TE-WS5-147-064, TE-WS5-148-065 THRU TE-WS5-148-096, TE-WS5-149-097 THRU TE-WS5-149-128, TE-WS5-150-129 THRU TE-WS5-150-160, TE-WS5-151-161 THRU TE-WS5-151-192, TE-WS5-152-193 THRU TE-WS5-152-224. OTHER TE'S ARE CALLED OUT IN FULL.



KEY PLAN



TANK ELEVATIONS

CONTROLLED DOCUMENT CLASS I

RCRA CONTROLLED DRAWING

NO.	DATE	REVISIONS	APPVD ANC	APPVD ENGR	APPVD	APPVD AEC	APPVD AEC H&S	APPVD AEC E&C
5	6-29-79	REVISED PER DCN #155754-AB50	MW					
4	5-16-79	REVISED PER DCN #155754-AB32	BVBA					
3	7-1-77	SEE DCN #3 83-218 adg.						
2	1-1-76	AS BUILT JWT	JWT					
1	12-29-75	REV TE NOS & NOTE 3	KL					

	BY	DATE
DESIGNED	RKL	4-1-75
DRAWN	GDJ	1-15-76
CHECKED	JKGRAY	4-1-75
APPROVED		

APPROVALS

ORGAN.	BY	DATE
ANC		
ACC		5-7-79
AEC		
AEC		
AEC H & S		
AEC E & C		

SCALE NONE

DATE ISSUED 5-7-79

EG&G Idaho, Inc.

FOR

U. S. ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION

IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP-765
5TH SET CALCINED SOLIDS STORAGE BINS

THERMOCOUPLE LAYOUT WS5

DWG. NO. 158523 REV 5

INDEX CODE NUMBER

AREA	DWG. TYPE	CL	ORIG.	SERIAL
200	765	2	8	220158523

S-218 K PROJECT NO.

REVISIONS						
ZONE	LTR	DESCRIPTION	DWN	CHK.	DATE	APPROVED
	6	ACTIVATED PER DCN# 155754-AB8	JPD	[illegible] 4/4/94	4-1-94	RSA 6-8-94 DJS 6-8-94
	7	REVISED PER DCN# 155754-AB51	MW 6-28-94	GS 6-28-94		DJS 6-28-94 DBS 6-28-94

VES. NO.	DIM. A	DIM. B	DIM. C	DIM. D
154	67'-11½"	21'-11 5/8"	13'-5 1/4"	5'-0 1/4"
155	67'-11⅞"	21'-11⅞"	13'-6 3/8"	5'-0 1/4"
156	67'-11 3/8"	22'-0 1/4"	13'-6 1/4"	5'-0 3/8"
157	67'-11⅝"	21'-11½"	13'-5⅞"	5'-0"
158	67'-11⅞"	22'-0½"	13'-6 1/4"	5'-0"
159	68'-0"	22'-0 3/8"	13'-6"	5'-0"
160	68'-0"	22'-0 3/8"	13'-6"	5'-0"

NOTES:
1. UNLESS NOTED OTHERWISE ALL MAT'L SHALL BE 304L SST.
2. BIN WORKING TOLERANCES
   OVERALL HEIGHT ±1"
   OD OF BINS ±1"
   MISALIGNMENT OF ℄ TOP TO BTM ± ½"
   NOZZLE POSITION ± ¼"
   MISALIGNMENT OF NOZZLES A & B FROM BIN ℄ ± ¼"
   LEVELING RING ± 1/8" ON I.D. & O.D. ONLY - NOT FLATNESS
   ANCHOR BOLT ASS'Y ± 1/8"
   ANCHOR RING ASS'Y ± 1/8"
   ALL OTHERS ± 1/8" UNLESS NOTED
3. SUPPORTS FOR NOZZLES A & B SHALL NOT BLOCK LINE OF SIGHT THRU RETRIEVAL NOZZLES C, D, E & F
4. SEE MASON STEEL DWG. NO. P-4790-81

NOZZLE J ON VES-WS-G-156 & 159 ONLY

ASME FLANGED & DISHED HEAD 13'-6 OD x 10" ICE x 12'-0 DISH RAD x 2" SF x 1 1/16" TH'K

INNER SHELL R 9/16" TH'K

ASME FLANGED & DISHED HEAD 13'-6 O.D. x 10" ICE x 12'-0 DISH RAD. x 2" S.F. x 1" THK

PIPE, 2" SCH 80 R 1" TH'K, 2 PLACES

THIS THERMOWELL ON VES-WS-G 155, 156, 157, 158, 159 & 160

THIS THERMOWELL ON VES-WS-G-154 ONLY

TYP HORIZ SEAM

TYP VERT SEAM

ELEVATION

RCRA CONTROLLED DRAWING

CONTROLLED CLASS 1 DOCUMENT

ENICO	[illegible]	11/12/80
STRESS	D. P. Trimble	11/12/80
DESIGN SUPRV.	[illegible]	11/12/80
DESIGN	D. E. Judy	11-12-80
CHECKED	J. P. Bussiere	11-12-80
DRAWN	A. BERKHUEST	DATE 9-5-80

EG&G Idaho, Inc.
FOR
US DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

TITLE CPP AREA STEUCT 791
6th SET CALCINED SOLIDS STORAGE BINS ELEVATION (SECTION)

W56

INDEX CODE NUMBER					
AREA	DWG. TYPE	CL.	ORIG.	SERIAL	
200	079	1	220	160283	

SCALE: 3/8" = 1'-0"
DATE ISSUED: 11/12/80

DWG. NO. 1570-CPP-791-S1
REV. 7

Subcontract No. 32189 PROJECT NO.

PLAN HOLD CORPORATION • IRVINE, CALIFORNIA

EXHAUST PLENUM ROOM

FAN ROOM

INLET PLENUM ROOM

CYCLONE CELL ROOM

OFF-GAS FILTER ROOM

CPP-791 VAULT

INSTRUMENT ROOM

MANHOLE MAH-WCS-HS-259

KEY PLAN

FAN ROOM / EXHAUST PLENUM ROOM / OFF-GAS FILTER ROOM / CYCLONE CELL / INSTRUMENT ROOM / INLET PLENUM ROOM / YARD

FLOW INDICATOR NUMBER & VALVE #	CONNECT TO AP LINE CONTAINING VALVE # INDICATED BELOW	ZONE
FI-WS6-LA-1, LAV-WS6-14	LAV-WS6-28	C-3
FI-WS6-LA-2, LAV-WS6-15	LAV-WS6-27	C-3
FI-WS6-LA-3, LAV-WS6-16	LAV-WS6-26	C-3
FI-WS6-LA-4, LAV-WS6-17	LAV-WS6-30	C-3
FI-WS6-LA-5, LAV-WS6-18	LAV-WS6-29	C-3
FI-WS6-LA-6, LAV-WS6-19	LAV-WS6-32	C-3
FI-WS6-LA-7, LAV-WS6-20	LAV-WS6-31	C-3

NO.	REVISIONS	DRAFTING CHECKING ENGR DATE	DRAFTING CHECKING ENGR DATE
20	AS-BUILT AS OF 4-21-04 SEE DAR 111358	VKJ DEJ 4-21-04	7/29/04
19	AS-BUILT AS OF 10/13/03 SEE DAR 106697	VKJ DEJ 11-13-03	12-03-03

RCRA CONTROLLED

NOTE:
1. CALCINER PROCESS CLOSURE BOUNDARY VALVE SECURED CLOSED.
2. CALCINER SYSTEM CLOSURE BOUNDARY (DOE/ID-10801).

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

CPP-791
CALCINED SOLIDS STORAGE
BIN SET #6
P & ID

WS6

APPROVALS	SIGNATURE	DATE
DRAFTING		
CHECKER		
DFTA SUPV		
ENGRG ENGR		
SYS ENGR		
ENGR MGR		
PROJ MGR		

SCALE NONE
DATE ISSUED

DWG SIZE	INDEX CODE NUMBER: AREA	DWG TYPE	CL	CONS	SERIAL	DRAWING NUMBER	REV.
E	200	0791	24	220	161425	161425	20

INDEX CODE NUMBER: AREA 200 | DWG TYPE 0673 | CL 24 | CONS 220 | SERIAL 161425

161424, 161425

JOB NUMBER 155754

TAKEN FROM DRAWING NO. & 161426

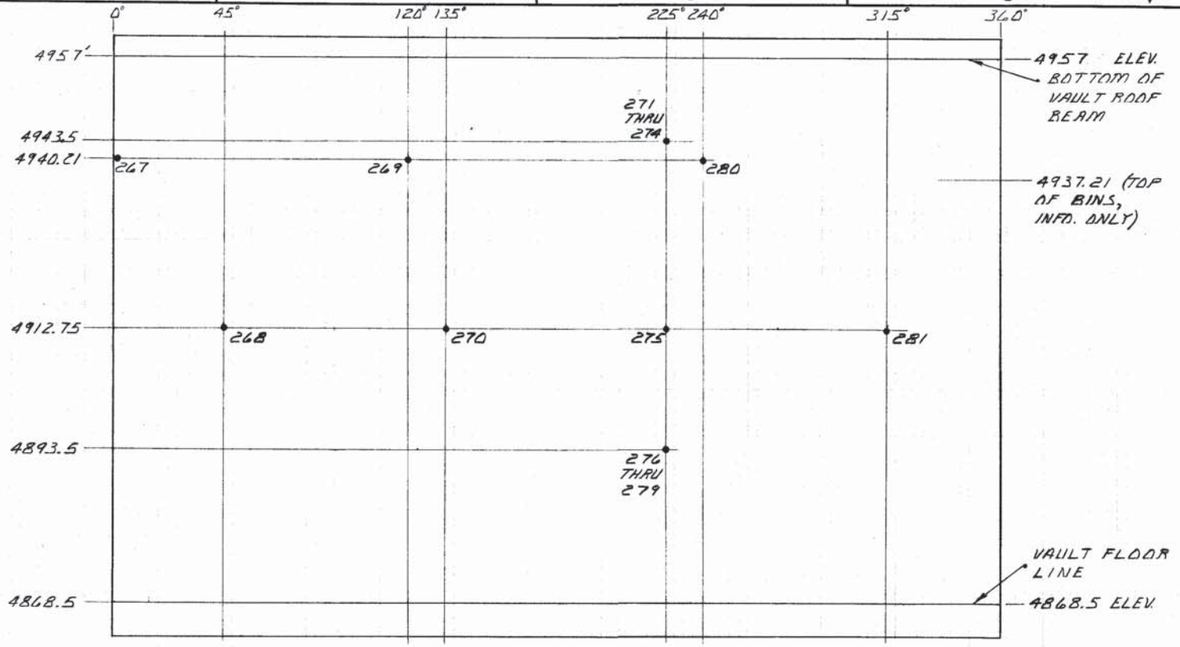
ORIGINAL - RED ENGRAVED ON

ID: KRESV

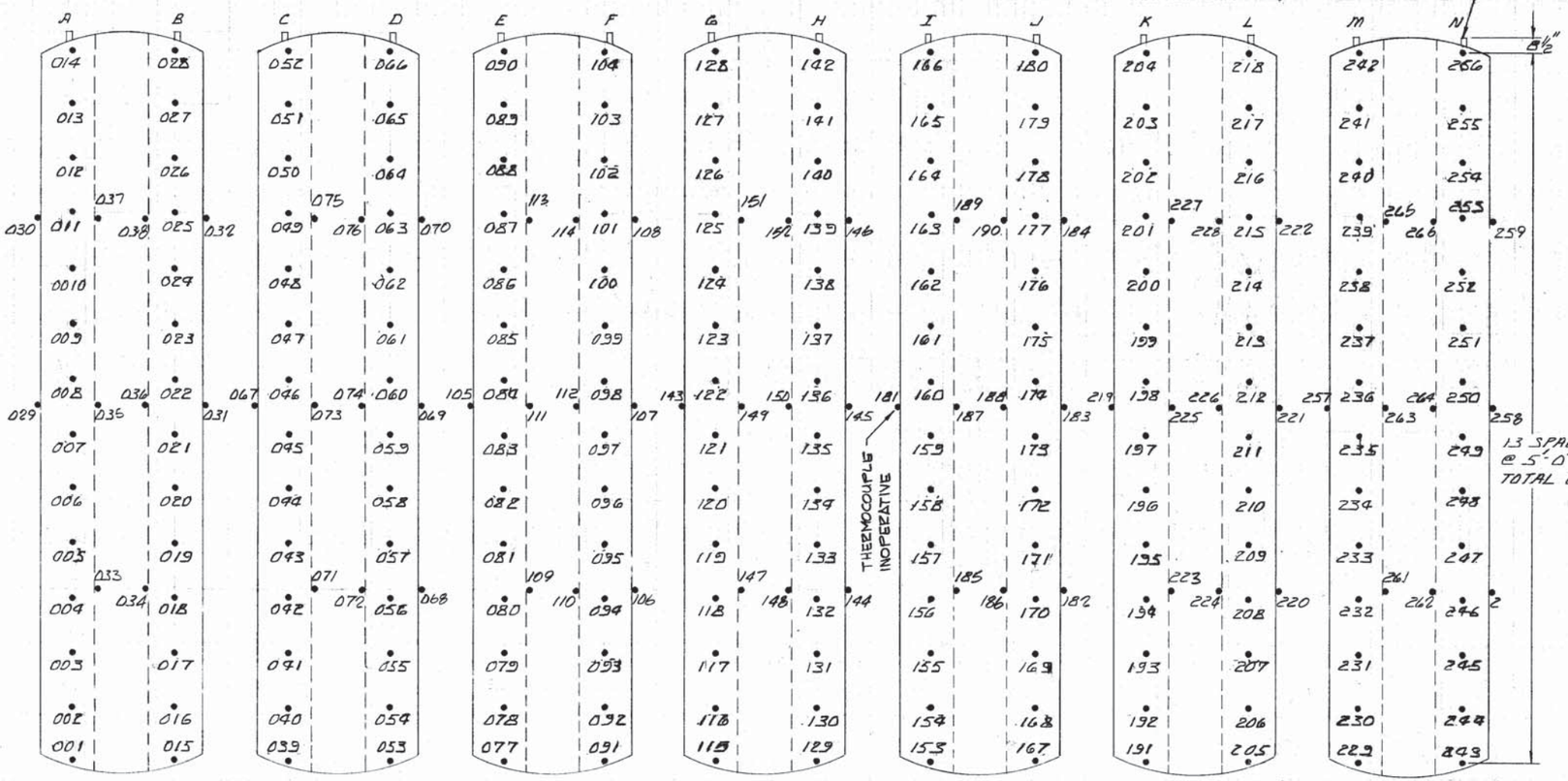
Drawn by KRESV Service
Date: 07/29/04 — 08:06 A.M.

File: 161425-20.dwg
Path: Q:\Customer\Revit

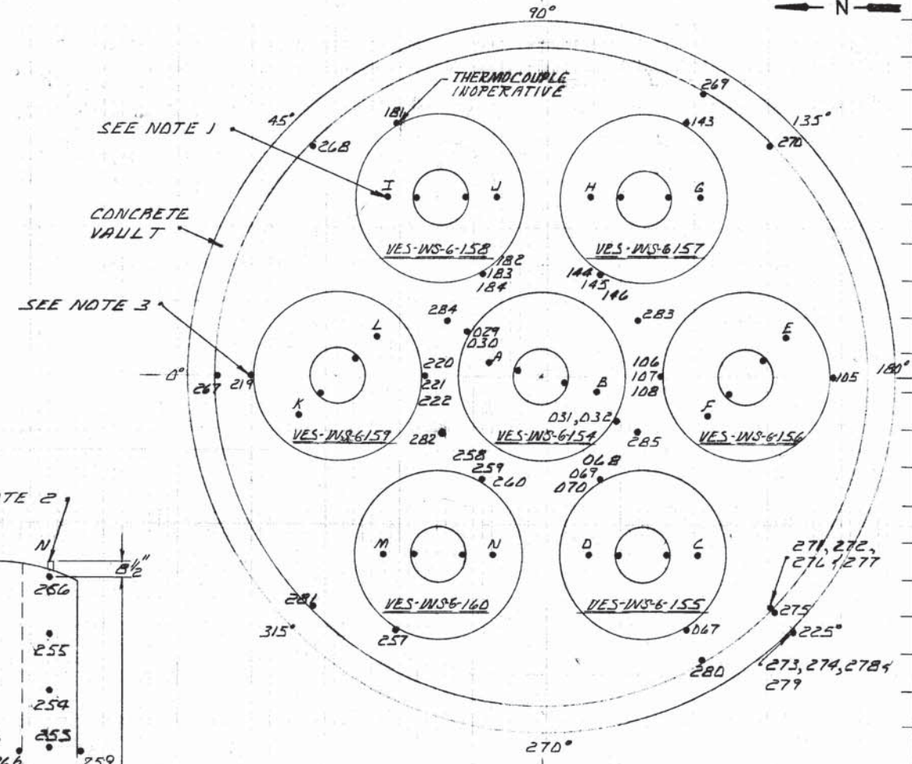
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	GS'-0 WAS GS'-8½ ECR 112	3-30-82	TWR, KMR
	2	AS BUILT	10-14-82	ARE
	3	REVISED PER DCN #155754/AB53 MW 6-24-94 GS 6-28-94 JW 8-8-94		



DEVELOPMENT OF VAULT CONCRETE CYLINDER



TANK ELEVATIONS



KEY PLAN

NOTE

1. FOR THERMOCOUPLE NUMBERS SEE TANK ELEVATIONS.
2. MULTIPOINT THERMOCOUPLE ASSEMBLY DIMENSIONS ARE SHOWN FROM THREADED END OF THERMOWELL.
3. ONLY THE LAST THREE NUMBERS OF EACH TE ARE SHOWN. COMPLETE THERMOCOUPLE NUMBER IS TE-WS6-791-001, TE-WS6-791-002 ETC..

RCRA CONTROLLED DRAWING

CONTROLLED CLASS 1 DOCUMENT

EMCO		11-17-81
		11-19-81
DESIGN SUPRV.		11-17-81
DESIGN	BK Ford	11/17/81
CHECKED	JKGRAY	11-17-81
DRAWN	T.M. WOODS	DATE 7-15-81

INDEX CODE NUMBER

AREA	DWG. TYPE	CL	ORIG.	SERIAL
200	079	1	25220	1-1448

SCALE: NONE

DATE ISSUED: 11-19-81

EG&G Idaho, Inc.

FOR

US DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE

IDAHO FALLS, IDAHO

TITLE CPP. AREA STRUCT. 791

6TH SET CALCINED SOLIDS STORAGE FACILITY

THERMOCOUPLE LAYOUT

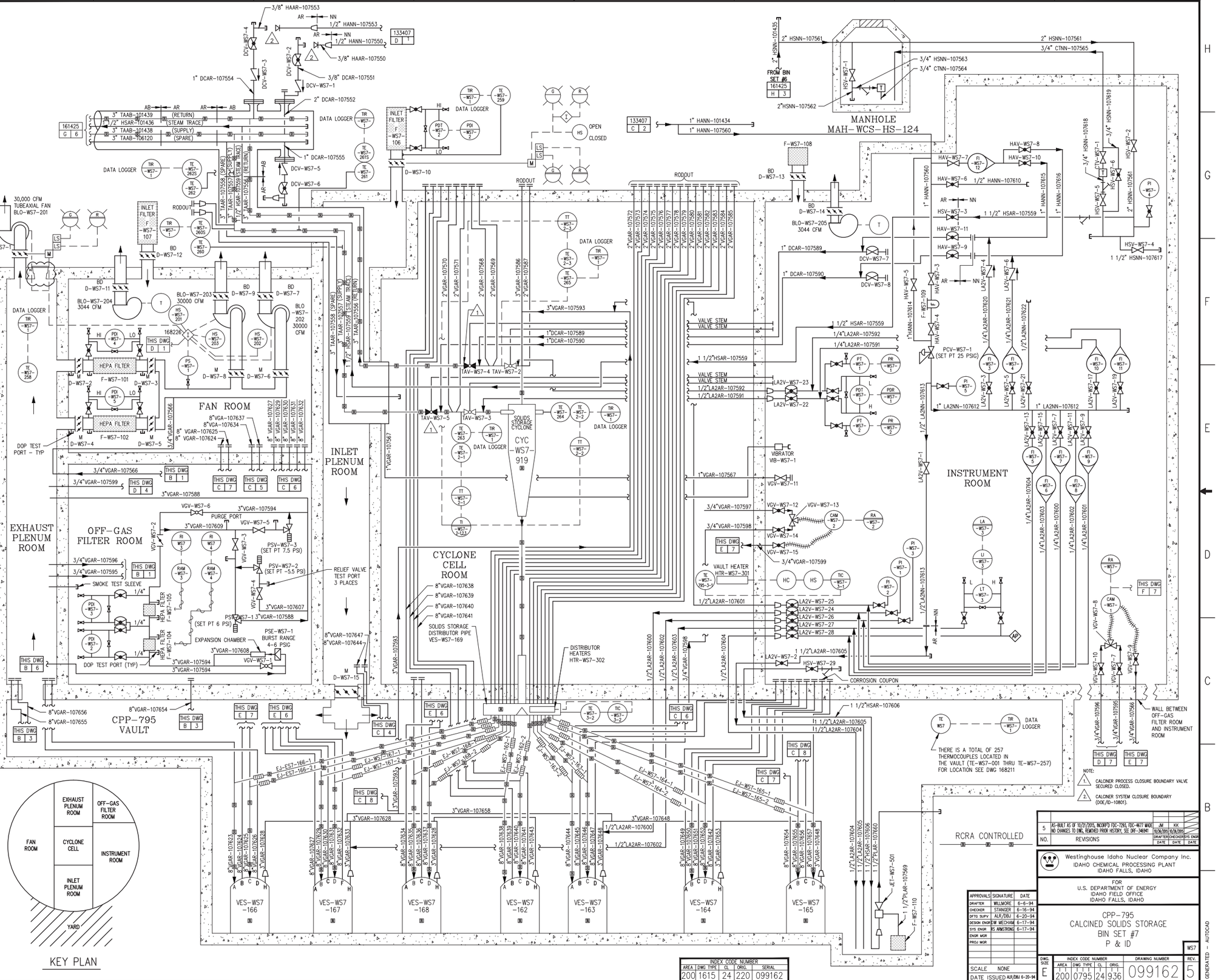
WSG

DWG. NO. 1570-CPP-791-T-2 REV. 3

PROJ. NO.

11669

* U.S. GPO NO. 697-601



THERE IS A TOTAL OF 257 THERMOCOUPLES LOCATED IN THE VAULT (TE-WS7-001 THRU TE-WS7-257) FOR LOCATION SEE DWG 168211

NOTE:
1. CALCINER PROCESS CLOSURE BOUNDARY VALVE SECURED CLOSED.
2. CALCINER SYSTEM CLOSURE BOUNDARY (DOE/ID-10801).

NO.	REVISIONS	DRAFTER	CHECKER	ENGR
5	AS-BUILT AS OF 10/31/2015, INCORP'D FDC-7291, FDC-4677 MADE NO CHANGES TO DWG, REMOVED PRIOR HISTORY, SEE DRF-346941	JM 10/26/2015	KK 10/26/2015	

Westinghouse Idaho Nuclear Company Inc.
IDAHO CHEMICAL PROCESSING PLANT
IDAHO FALLS, IDAHO

FOR
U.S. DEPARTMENT OF ENERGY
IDAHO FIELD OFFICE
IDAHO FALLS, IDAHO

CPP-795 CALCINED SOLIDS STORAGE BIN SET #7 P & ID

APPROVALS	SIGNATURE	DATE
DRAFTER	WILLMORE	6-6-94
CHECKER	STANGER	6-16-94
DFTG SUPV	ALR/DBJ	6-20-94
DESIGN ENGR	DW MECHAM	6-17-94
SYS ENGR	RS WINSTRONG	6-17-94
ENGR MGR		
PROJ MGR		

SCALE NONE
DATE ISSUED ALR/DBJ 6-20-94

DWG. SIZE	INDEX CODE NUMBER					DRAWING NUMBER	REV.
	AREA	DWG TYPE	CL	ORIG.	SERIAL		
E	200	0795	24	936		099162	5

WS7

INDEX CODE NUMBER

AREA	DWG TYPE	CL	ORIG.	SERIAL
200	1615	24	220	099162

JOB NUMBER 155754

TAKEN FROM DRAWING NO. 168166,168167, 168168,168169 & 168170

CAD GENERATED - AUTOCAD

ID: MWJ

Date: 10/26/15 - 9:17 AM Layout Name: Model

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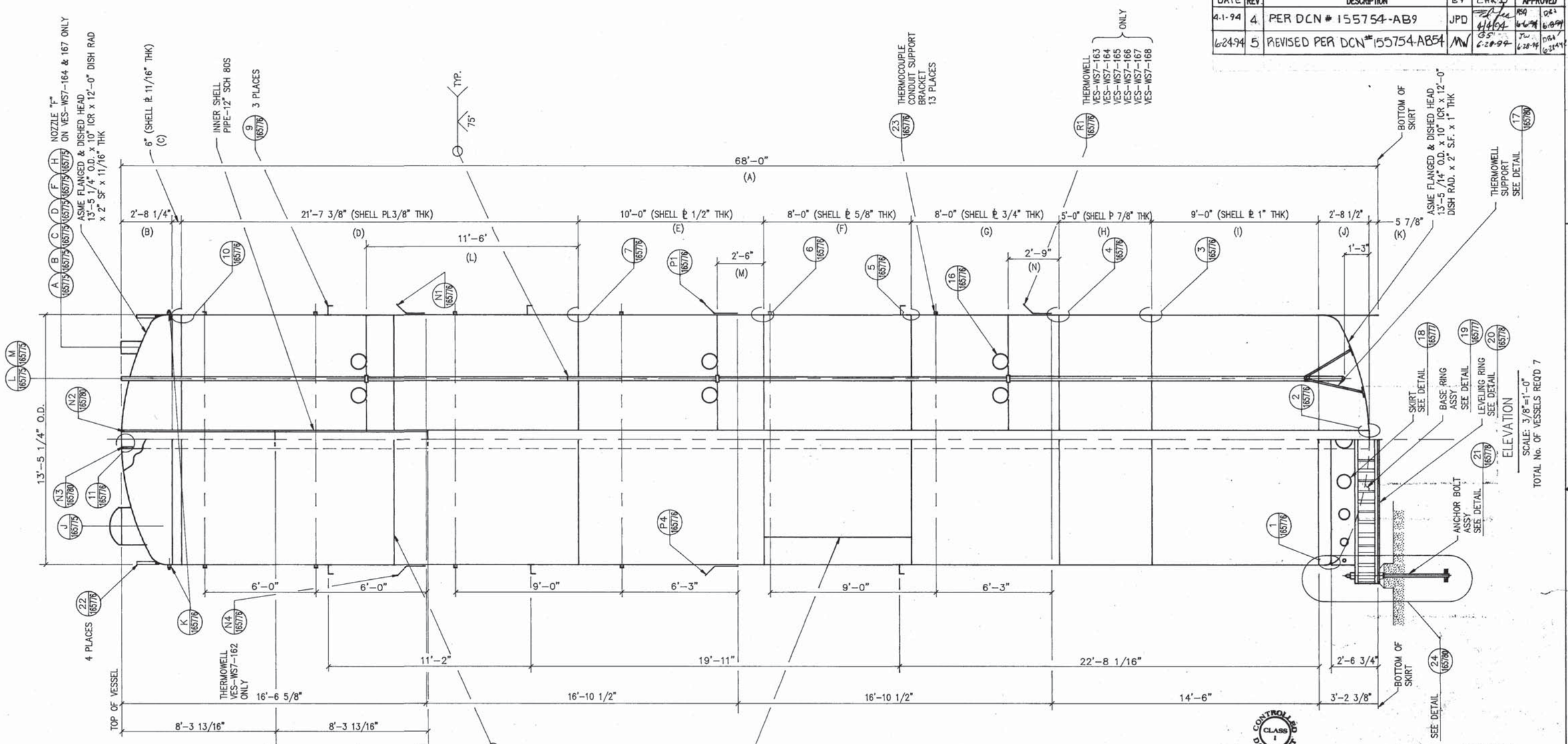
Path: A:\NTS_Mike\Drawings\DRF_346941

REVISIONS					
DATE	REV.	DESCRIPTION	BY	CHKD	APPROVED
4-1-94	4	PER DCN # 155754-AB9	JPD	[illegible] 4/4/94	RSJ 6-6-94 / DRJ 6-8-94
6-24-94	5	REVISED PER DCN # 155754-AB54	MW	GS 6-28-94	JW 6-28-94 / DRJ 6-28-94



GENERAL NOTES:

1- UNLESS NOTED OTHERWISE ALL MAT'L SHALL BE 304L SST

2- VESSEL WORKING TOLERANCES:
OVERALL HEIGHT ±1"
O.D. OF BINS +1 3/4" -1/4"
MISALIGNMENT OF TOP TO BTM 1/2"
NOZZLE POSITION ±1/4"
MISALIGNMENT OF NOZZLES L & M FROM BIN ±1/4"
LEVELING RING ±1/8"
ANCHOR BOLT ASSY ±1/8"
BASE RING ASSY ±1/8"
HEAD TOLERANCES PER ASME CODE
ALL OTHERS ±1/8" UNLESS NOTED OTHERWISE

3- SUPPORTS FOR NOZZLES L&M SHALL NOT BLOCK LINE OF SIGHT THRU RETRIEVEL NOZZLES A,B,C,& D

4- PREASSEMBLE VESSEL W/SKIRT (DETAIL 18), BASE RING ASSY (DETAIL 19), LEVELING RING (DETAIL 20) & ANCHOR BOLT ASSY (DETAIL 21) INDEX AND MATCH MARK. SEE DWG. 165779 FOR MATCH MARK LOCATION.

5- CONSTRUCTED I.A.W. ASME SECTION VIII DIVISION 2 WINTER ADD. OF 84.

6- AS-BUILT DIMENSION ARE SHOWN ON AS-BUILT DIMENSION TABLE ON DWG. 165779

RCRA CONTROLLED DRAWING

QUALITY LEVEL I

CONTROLLED DOCUMENT CLASS I

FOR DRAWING INDEX SEE DRAWING NO. 168100

SCALE: 1"= 1" IN 1/10"

SCALE: 1"= 1" IN 1/16"

DO NOT SCALE DRAWING

DESIGN PHASE	DATE APPROVED
TITLE I	
TITLE II	
APPROVED FOR CONSTRUCTION	

WINCO A.R. EBERLE		4-2-85
DESIGN MGR L.D.T.		4-2-85
DESIGN D.E. JUDY		4-2-85
CHECKED C.R. LEAVITT		4-2-85
DRAWN T.G. BESERIS	DATE	4-2-85
PROJECT NO. EA 95510		
SUBCONTRACT NO. S-2514		
ISSUED FOR CONSTRUCTION 4/2/85		

EG&G Idaho, Inc.
A/E CONTRACT NO. 1570
FOR
U.S. DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP STRUCT. 795

7TH SET CALCINED SOLIDS STORAGE FACILITY BINS

ELEVATION SECTION WS7

SIZE	INDEX CODE NUMBER AREA	DWG. TYPE	CL.	ORIG	DRAWING NO.	REV.
D	200	079	53	220	165772	5

SCALE NOTED SPEC. CODE A/E SHEET NO. M-1

PLAN HOLD CORPORATION • IRVINE, CALIFORNIA

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
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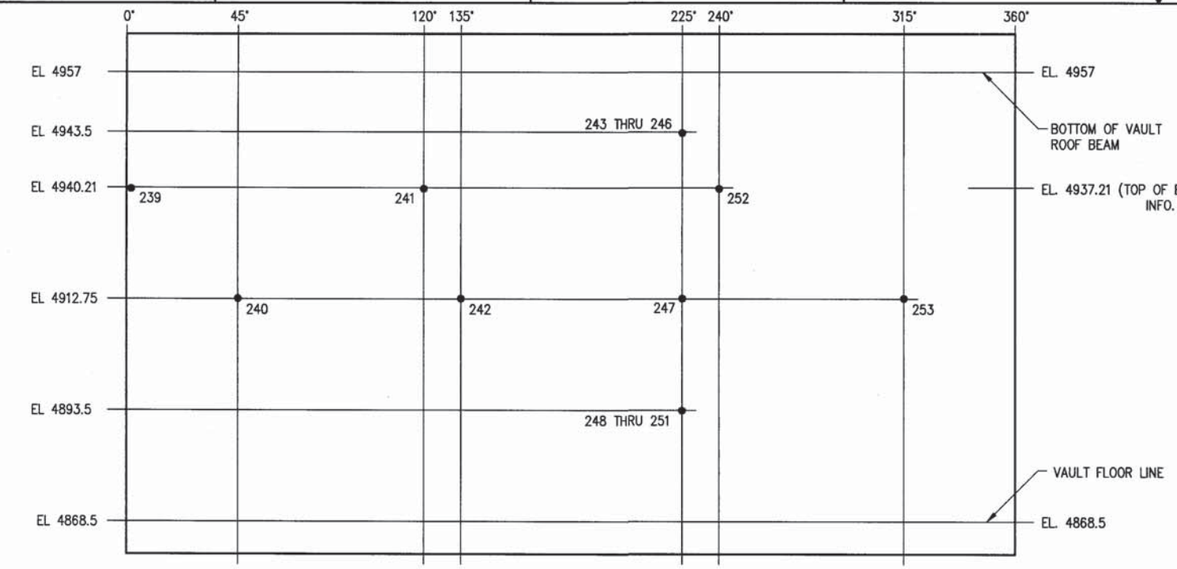
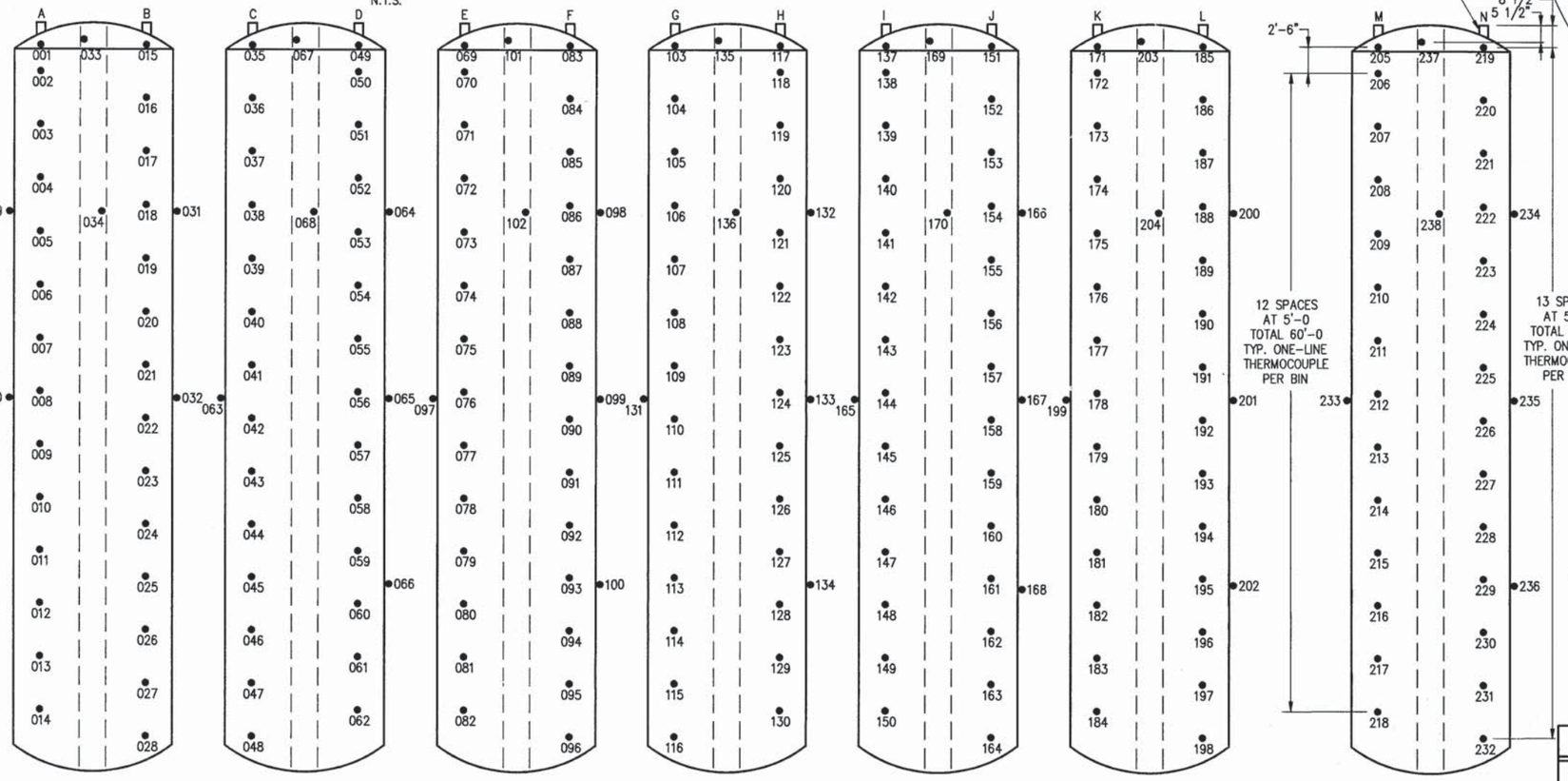
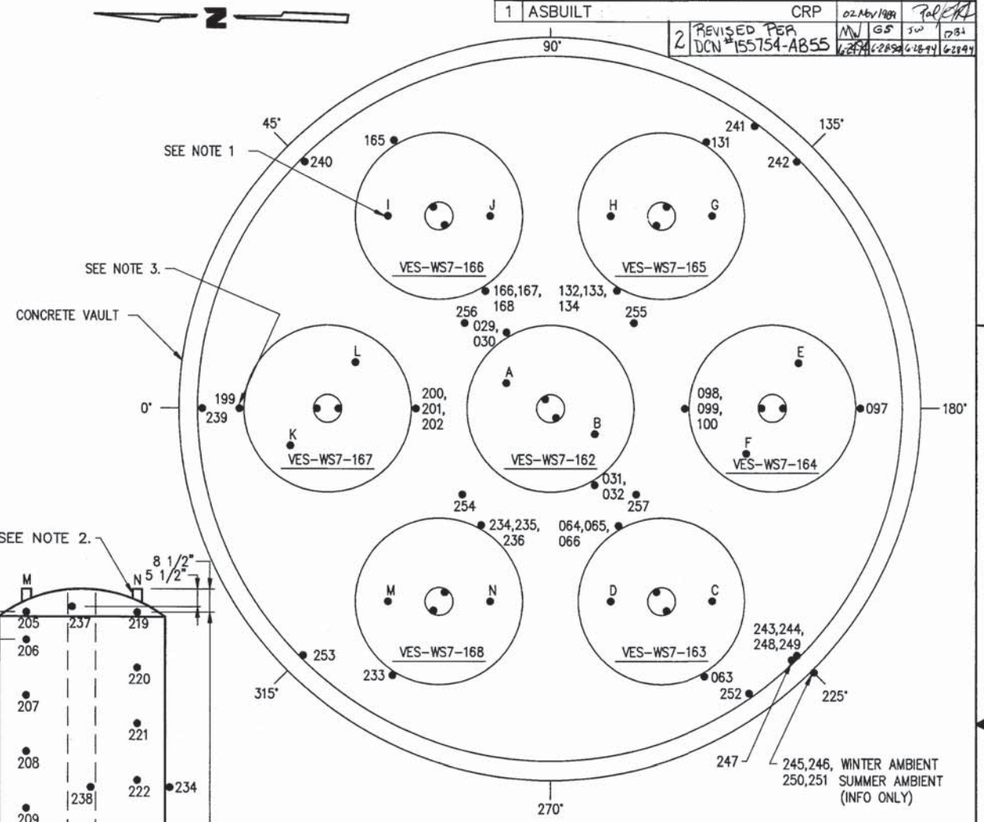
2	REVISED PER DCN #155754-AB55		



DEVELOPMENT OF VAULT CONCRETE CYLINDER
N.T.S.



TANK ELEVATIONS
N.T.S.



KEY PLAN
SCALE: NONE

NOTES:
1- FOR THERMOCOUPLE NUMBERS SEE TANK ELEVATIONS.
2- MULTIPOINT THERMOCOUPLE ASSY. DIMENSIONS ARE SHOWN FROM THREADED END OF THERMOWELL.
3- ONLY THE LAST THREE NUMBERS OF EACH T.E. ARE SHOWN. COMPLETE THERMOCOUPLE NUMBER IS TE-WS7-795-001, TE-WS7-795-002, ETC.

RCRA CONTROLLED DRAWING

CONTROLLED CLASS 1 DOCUMENT

FOR DRAWING INDEX SEE DRAWING NO. 168100

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SCALE: 1"= 1" IN 1/10"

0 1" 2"
SCALE: 1"= 1" IN 1/16"

DO NOT SCALE DRAWING

DESIGN PHASE	DATE APPROVED
TITLE I	
TITLE II	
APPROVED FOR CONSTRUCTION	

WINCO A.R. EBERLE	6/6/86	
DESIGN MGR J.E. DUGGAN	6-6-86	
DESIGN T.H. WOODS	6-6-86	
CHECKED J.K. GRAY	6-6-86	
DRAWN T.G. BESERIS	DATE 6-6-86	
PROJECT NO. EA 95510		
SUBCONTRACT NO. S-2514		
ISSUED FOR CONSTRUCTION 6/6/86		

EG&G Idaho, Inc.
A/E CONTRACT NO. 1570
FOR
U.S. DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

CPP STRUCT. 795

7TH SET CALCINED SOLIDS STORAGE FACILITY

THERMOCOUPLE LAYOUT WS7

SIZE	INDEX CODE NUMBER AREA	DWG. TYPE	CL	ORIG	DRAWING NO.	REV.
D	200	0795	25	220	168211	2

SCALE NONE | SPEC. CODE | A/E SHEET NO. 1-2

QUALITY LEVEL

DATE ISSUED 1-23-90 SYS. ENG.

12/4/89

112801

Appendix 2
CSSF Integrity Assessment

RCRA PART B PERMIT REAPPLICATION

FOR THE
IDAHO NATIONAL LABORATORY

VOLUME 22
IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

APPENDIX 2

TANK SYSTEM INTEGRITY ASSESSMENT FOR THE CALCINED SOLIDS STORAGE FACILITY BIN SETS AT THE IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER

MAY 2016

TANK SYSTEM INTEGRITY ASSESSMENT FOR THE CALCINED SOLIDS STORAGE FACILITY BIN SETS AT THE IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER

REVISION 1
FINAL

Completed for
Bechtel BWXT Idaho
Under
Blanket Master Contract No. 00000118,
Release No. 3, Amendment No. 1

June 2003

Prepared by
Jason Associates Corporation
Idaho Falls, Idaho
Under
Work Order 2336-001-3

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1. CERTIFICATION

Tanks Systems Being Certified

The tank systems being addressed by this attestation are the hazardous waste tank systems located within the seven (7) Calcined Solids Storage Facility Bin Sets at the Idaho Nuclear Technology and Engineering Center (INTEC) within the Idaho National Engineering and Environmental Laboratory (INEEL). These tank systems are further described in Sections 2 and 3 of this document.

Attestation

The calcine storage bin elements of the tank systems are adequately designed and have sufficient structural strength and compatibility with the wastes being stored to provide reasonable assurance that they will not collapse, rupture, or fail.

The vaults that contain the bins, if considered part of the tank system, are adequately designed and have sufficient structural strength to provide reasonable assurance that they will not collapse or fail.

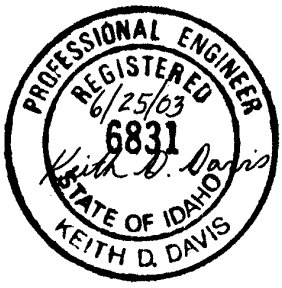
This attestation is also contingent upon certain conditions and limitations, which are identified in this assessment.

Certification

Relying in part upon documentation and statements of fact provided by INEEL personnel and in attached assessments provided by other qualified, registered professional engineers, 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.

Keith D. Davis, P.E.
Idaho P.E. Registration #6831
Jason Associates Corporation

Date: June 25, 2003



2. INTRODUCTION

Hazardous waste regulations promulgated pursuant to the Resource Conservation and Recovery Act (RCRA) and the corresponding Idaho Hazardous Waste Management Act (HWMA) address the operation of hazardous waste tank systems (40 CFR Part 265, Subpart J). The tank system regulations include a requirement [40 CFR 265.191(a)] that the owner or operator of an existing tank system without secondary containment obtain and keep a written assessment that attests to the tank system's integrity. It is further required that this assessment be reviewed and certified by an independent registered professional engineer. The preceding certification attests to the integrity of the hazardous waste tank systems located within the seven Calcined Solids Storage Facility (CSSF) Bin Sets at the Idaho Nuclear Technology and Engineering Center (INTEC) within the Idaho National Engineering and Environmental Laboratory (INEEL). The remainder of this section presents additional background on the CSSF Bin Sets and their usage as well as on an earlier version of this document. The subsequent sections of this document present the written assessment of the tank systems upon which the certification is based.

The U.S. Department of Energy (DOE) processed spent/irradiated nuclear fuel at INTEC from 1952 to 1992 in order to recover enriched uranium. In simple terms, spent nuclear fuel units were dissolved and the enriched uranium was extracted from the solution, with the remaining material being managed as waste. This process generated an acidic, highly radioactive liquid waste that was stored in large underground tanks at the INTEC Tank Farm. When spent fuel reprocessing was discontinued, other highly radioactive liquid waste, from processes such as subsequent extraction cycles and decontamination activities, continued to be generated and stored in the Tank Farm. From December 1963 through May 2000, liquid radioactive waste from the Tank Farm was converted to a dry, stable granular form by periodically processing (in campaigns) the liquid through a calciner treatment process. In this process, the waste was injected into a high-temperature (400 to 600° C) air-fluidized bed of granular solids where the liquid portion of the radioactive waste evaporated and solids adhered to the granular material, or calcine. This material was actually produced from two separate calciner facilities: the Waste Calcining Facility (WCF) operated from 1963 to 1981, and the New Waste Calcining Facility

(NWCF) operated from 1982 to 2000. In both facilities, the calcine was collected from the off-gas and bed build-up as the treatment proceeded and was moved pneumatically to stainless steel bins for storage. Storage in this form has always been intended to be interim in nature. Though the bins were designed with a 500-year life (Berreth 1988), the calcine is considered retrievable for ultimate disposal in a repository or other site when available.

The bins that received the calcine are located in groups or sets with each group housed within a vault. Over the years, there have been seven different Bin Sets constructed, each containing a grouping of stainless steel bins. The tanks that are the subject of this assessment are the stainless steel bins that are located within the CSSF Bin Sets as described below:

CSSF Designation	Bin Set Description
Bin Set #1	Contains 4 composite bins. Each composite bin consists of two concentric, ring (annular) tanks with a third, right-circular cylindrical tank located in the middle. There are gaps, several inches in width, between the two annular tanks and between the inner annular tank and the cylindrical tank to support movement of cooling air between the tanks. The annular tanks are 20-feet tall and the outer one has an outside diameter of 142 inches and an inside diameter of 94 inches. The inner annular tanks have a similar annular thickness of about 50 inches. The cylindrical tank in the center is 25 feet tall and has a 36-inch inside diameter. The tanks are constructed of Type-405 stainless steel. The four composite bins have a combined capacity of about 8,000 cubic feet and contain about 7,700 cubic feet of calcine. The rectangular concrete vault that houses the Bin Set is underground.
Bin Set #2	Contains 7 bins or tanks, each a right circular cylinder about 42 feet tall and 12 feet in diameter. The vertical tanks are arranged with six of them in a circular pattern that is centered on the seventh. The tanks are

constructed of Type-304 stainless steel and have a combined capacity of about 30,200 cubic feet. They are filled to capacity with calcine. The cylindrical concrete vault that houses the Bin Set is predominantly below ground level with earth banked up against the portion that is above ground level.

Bin Set #3 — Contains 7 bins or tanks, with a design and layout very similar to that of Bin Set #2. Except that the six bins arranged in the circular pattern are about 53-feet tall and the inner, central bin is 61 feet tall. (Each bin has a diameter of about 12 feet.) The 7 bins have a combined capacity of about 38,700 cubic feet and are filled to near-capacity with calcine. The concrete vault that houses Bin Set #3 has a configuration similar to that described for Bin Set #2.

Bin Set #4 — Contains 3 bins or tanks, each a right circular cylinder about 55 feet tall and 12 feet in diameter. The tanks are constructed of Type-304 stainless steel and have a combined capacity of about 17,200 cubic feet. They are filled to capacity with calcine. The cylindrical concrete vault that houses the Bin Set is partially below ground level.

Bin Set #5 — Contains 7 bins or tanks, each a right circular cylinder about 50 feet tall, with an outer diameter of 12 feet. These tanks are annular in design with the open interior annulus being 4 feet in diameter (i.e., this is the inner diameter of the annular tank). The 7 tanks are arranged in the same pattern as are the tanks in Bin Sets #2 and #3 (i.e., six of them in a circular pattern centered on the seventh). The tanks are constructed of Type-304L stainless steel, have a combined capacity of about 35,000 cubic feet, and are filled to capacity with calcine. About half of the cylindrical concrete vault that houses the Bin Set is below ground level.

Bin Set #6 — Contains 7 bins or tanks, with a design and layout very similar to that of Bin Set #5. Except that each of the seven annular tanks is about 68 feet tall with 13.5-feet outer and 5-feet inner diameters. The 7 bins have a combined capacity of about 53,200 cubic feet and are only partially full containing about 26,200 cubic feet of calcine. Based on the CSSF filling timelines presented in Appendix B of Staiger (1999), it is believed the calcine in this Bin Set is fairly evenly distributed among the 7 bins. The concrete vault that houses this Bin Set has a configuration similar to that described for Bin Set #5.

Bin Set #7 — Contains 7 bins or tanks which are laid out in the same pattern as are the bins in Bin Sets #5 and #6. The bins have the same outer dimension as those in Bin Set #6 (i.e., 68 feet tall and 13.5 feet in diameter), but the annular space is limited to a 12-inch schedule 80 pipe extended through the (long axis) center of each bin. These bins are constructed of Type-304L stainless steel, have a combined capacity of about 63,000 cubic feet, and are empty (i.e., no calcine has been added). The concrete vault containing this Bin Set has a configuration similar to those for Bin Sets #5 and #6.

This document was originally issued in November 2002. The findings of the structural analysis performed at that time included potential concerns with regard to loading capacities of Bin Set #1 and its vault. The concerns, however, included the caveat that conservative assumptions had been made as necessary to fill information gaps on the Bin Set and Bin Set vault designs. Subsequent to the initial report, INEEL personnel indicated that additional design information could be located and requested that the structural analysis be performed again to incorporate the additional information. The current document, Revision 1 of the Tank System Integrity Assessment, has been revised to incorporate the new Structural Engineering Evaluation and its results, including corresponding changes to the certification statement in Section 1. There have been no significant changes to the other elements of this Assessment compared to the original November 2002 version.

3. TANK SYSTEM INTEGRITY ASSESSMENT

The hazardous waste regulations that require a written assessment of a tank system's integrity, as described in Section 2 of this document, establish a minimum set of tank system elements that must be considered by the assessment. This minimum set of tank system elements is presented in Table 1 along with the applicable federal regulatory citation.

Table 1. Minimum set of tank system elements to be considered in tank integrity assessment.

Citation	Designation	Assessment Consideration
265.191(b)(1)	Design Standards	The assessment must consider the design standard(s), if available, according to which the tank and ancillary equipment were constructed.
265.191(b)(2)	Waste Characteristics	The assessment must consider the hazardous characteristics of the waste(s) that have been or will be handled.
265.191(b)(3)	Corrosion Protection	The assessment must consider the tank system's existing corrosion protection measures.
265.191(b)(4)	Tank Age	The assessment must consider the documented age of the tank system or, if not available, an estimated age of the tank system.
265.191(b)(5)	Integrity Examination	The assessment must consider results of a tank system integrity examination, which must be either (1) a leak test capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects, or (2) an internal inspection and/or other tank integrity examination certified by an independent, qualified, registered professional engineer that addresses cracks, leaks, corrosion, and erosion.

The tank system integrity examination requirements (see Table 1) described in the regulations vary depending on whether the tank is a non-enterable underground tank. Though the vaults containing the Bin Sets are partially or wholly underground, it is believed that the tanks or bins themselves do not meet the definition of underground tanks. Accordingly, the "Integrity Examination" requirement or consideration shown in Table 1 is based on the regulatory citation for "other than non-enterable underground tanks."

The remainder of this section addresses each of the assessment considerations identified in Table 1 with one difference. The first tank system consideration shown in Table 1 is being modified to include results of a structural analysis of the tank systems rather than simply identifying the design standards under which the tank systems were constructed. In order to adequately assess whether the tank systems have sufficient structural strength, it is reasoned that some structural analysis is appropriate to account for an incomplete record of design standards over time and to consider the potential for current design standards to be more conservative.

3.1 DESIGN STANDARDS AND STRUCTURAL ANALYSIS

A qualified (and certified) independent structural engineer evaluated design information made available on the bin structures and performed a conservative initial analysis with simplifying assumptions (also termed a "threshold analysis") to develop an overall general picture of the existing facilities with respect to current building codes. The analysis is intended to assist administrators and decision-makers to determine if there is a sufficient level of concern with respect to Bin Set structural elements to warrant further, more detailed analysis. The structural analysis effort and its results are documented in a separate report, developed and certified by the structural engineer, which is provided as Attachment A to this document. This section provides a summary of the structural engineer's analysis and findings from the structural integrity evaluation.

The structural evaluation considered both the stainless steel bins containing the calcine material and the buried, or partially buried, concrete vaults in which the bins are contained. Analyses were performed to identify structural responses to normally expected, everyday loads and also to seismic events reasonably predicted to occur at the INEEL site. With respect to analysis of the stainless steel bins, a temperature factor was added to the normal load analysis to account for the elevated storage temperatures generated by the radioactive decay of the calcine. The structural evaluation identifies the Uniform Building Code (UBC) as the governing code in Idaho for the past half-century, but recognizes that it has now been replaced by the International Building Code (IBC), which was adopted by the State of Idaho and by local jurisdictions beginning this

year (January 2003). Accordingly, the current version (2000) of the IBC is the standard used in the structural evaluation.

The structural analysis report incorporates carefully considered language on the limitations associated with the evaluation results. Some of the most important limitations are summarized as follows:

- The structural evaluation was conducted based solely on drawing information and reports; no site visit or physical inspection of the structures was performed as part of the effort. (The structural engineer was not precluded from a site inspection, but it was concluded that such an inspection would have no additional benefit because it would be severely limited by the high radiation fields associated with the Bin Sets.)

- Not all structures were evaluated. Similar structures were compared, and those that would generate worst-case results were selected by the structural engineer for analysis. Results of the limited analyses were then applied to the similar structures.

- The study is intended to provide a "threshold analysis" with conservative, simplifying assumptions, which establishes a beginning point for decision-making as to whether further investigation is warranted. This evaluation provides a "snapshot" of current conditions with respect to reasonably expected performance predicted by current building code.

Results of the structural analyses are detailed in the report along with appended calculations. A summary of those results are presented as follows for both the outer vaults and the stainless steel bins:

Concrete Vaults

- With respect to normal (non-seismic) loads, predicted stresses in all concrete vaults meet the provisions of the current 2000 IBC.

- With respect to earthquake loads, predicted stresses in all concrete vaults meet the provisions of the current 2000 IBC. Therefore, earthquake loadings will not be a problem for the concrete vaults of Bin Sets #1 through #7.

Stainless Steel Bins

- All bins are acceptable with respect to normal (non-seismic) loads, including when the temperature loading caused by the radioactive decay of the calcine is considered.

- With respect to earthquake loads, all stainless steel bins for Bin Sets #1 through #7 are acceptable in relation to the 2000 IBC.

The overall conclusion of the structural analysis is that the concrete vaults and stainless steel bin structures pass the threshold integrity assessment based on conservative assumptions. Since stresses in the structures meet current building code and no other structural concerns have been identified, it is also the conclusion of the effort that there is no need for further, more rigorous analysis.

3.2 WASTE CHARACTERISTICS

The tanks or bins within the 7 Bin Sets were all fabricated for the purpose of storing dry, granular calcine resulting from the treatment of liquid radioactive waste. Characteristics of the calcine produced by the treatment changed in accordance with the changes in the liquid waste feed that went into the treatment process. When the calcining process was put into operation at the INTEC, the primary waste feed was the liquid that resulted from processing and recovering enriched uranium from spent nuclear fuel. The spent fuels routinely processed involved aluminum, stainless steel, or zirconium as the primary fabrication material. INEEL documents present chemical characteristics of the calcine based on these different feed materials. In more recent years, since spent fuel processing was discontinued, the calcine has been characterized based on other types of waste feed. Liquid radioactive wastes generated from activities such as

decontamination and subsequent (after first cycle) processing of spent nuclear fuel solutions are generally high in sodium and potassium nitrates and are referred to as Sodium Bearing Wastes (SBW).

Berreth (1988) considered the nature of the liquid radioactive waste processed over time and which Bin Sets were receiving calcine during the corresponding time to develop estimates of the calcine composition by Bin Set for the first five sets. This information is shown in Table 2. The notably different characteristics of the calcine in Bin Set #1 is the due to the fact that the liquid waste processed during its filling was totally from processing the aluminum-based spent fuel. The contribution from this type of liquid waste decreased in the next two Bin Sets. Chemical characteristics of calcine generated more recently than shown in Table 2 are shown in Table 3. The reference in this case (DOE 2002), presents the information in a little different format, showing the primary elements rather than compounds. If it is assumed that the elements are contained in the same compounds shown in Table 2 (e.g., all Al is in the form of Al_2O_3), then simple calculations can be performed to show that the data in Table 3 is generally within the range of values shown in Table 2. Notable exceptions to this are that Table 3 shows much lower amounts of zirconium and fluoride than does Table 2 for Bin Sets #2 through #5, and a much higher amount of sodium than for any of the Bin Sets in Table 2. This is consistent with the fact that the most recent waste processed through the calciner was not generated from processing spent nuclear fuel; rather the liquid waste consisted of SBW.

The bulk density of the calcine is estimated to vary between 1.0 and 1.7 grams per cubic centimeter (g/cm^3), but is most generally near 1.4 g/cm^3 (Berreth 1988). The "zirconium-based" calcine is at the upper end of the density range, while the "aluminum-based" calcine is at the lower end of the range. Calcine generated from the SBW is estimated to have a density of about 1.2 g/cm^3 (Russell et al. 1998).

Table 2. Approximate calcine composition by Bin Set (for Bin Sets #1 to #5). [a]

Component	Weight %				
	Bin Set #1	**Bin Set #2**	**Bin Set #3**	**Bin Set #4**	**Bin Set #5**
Al_2O_3	90.6	39.5	23.8	14.2	14.2
ZrO_2	- - -	14.8	17.3	19.4	19.9
CaF_2	- - -	34.1	40.3	45.2	46.4
B_2O_3	0.6	2.1	2.3	2.6	2.6
Na_2O	3.1	1.0	1.9	4.2	3.6
K_2O	- - -	- - -	0.1	0.9	0.7
CaO	- - -	2.5	5.9	8.0	10.9
Fe_2O_3	0.6	0.3	0.2	0.3	0.2
Hg	2.9	1.0	- - -	- - -	- - -
SO_4	1.2	0.4	0.1	0.3	0.3
PO_4	- - -	- - -	0.1	0.1	0.2
Cl	- - -	0.1	0.1	0.1	0.1
Other	1	4 [b]	8.0 [b]	4.8 [b]	1.0
NO_3 [c]	1	1	~3.5	~5	~5

a. Source: Berreth (1988), Tables 4-3 and 4-4. Note: The referenced Table 4-3 also shows CdO and SnO_2, which are not depicted in Table 4-4 or in the table above.
b. Bin Sets #2, #3, and #4 includes about 3%, 7%, and 4%, respectively as dolomite ($CaMg(CO_3)_2$) start-up material.
c. NO_3 is presented as percent of total calcine composition

Table 3. Typical constituents of calcine produced in last calciner campaign (March through May 2000) [a]

Constituent [b]	Weight %	Constituent [b]	Weight %
Aluminum (Al)	33.4	Fluoride (F)	0.9
Oxygen (O)	33.2	Iron (Fe)	0.6
Sodium (Na)	17.0	Chloride (Cl)	0.5
Calcium (Ca)	3.7	Zirconium (Zr)	0.3
Nitrate (NO_3)	3.6	Boron (B)	0.1
Potassium (K)	3.2	Cadmium (Cd)	0.1
Sulfate (SO_4)	1.5	Other [c]	1.9

a. Source: DOE (2002), Table 1
b. Dominant compounds are metallic oxides and aluminates (Al_2O_3, $NaAlO_2$, etc.).
c. Minor species including radionuclides and trace components such as Hg, Cr, Ni, etc.

3.3 CORROSION PROTECTION

A qualified (and certified) independent corrosion engineer evaluated the existing corrosion protection measures found in the Bin Sets. The results of that effort, in the form of a letter report, are provided as Attachment B to this document. This section provides a summary of the corrosion engineer's analysis and findings from the corrosion protection evaluation.

The only corrosion control measure identified for the Bin Sets is the metallurgy, or selection of materials, used in the fabrication of the bins. The primary materials of construction for the bins are stainless steel, type-405, -304, and -304L. Based on the calcine characteristics provided (see Tables 2 and 3), the older and newer calcines are similar in their chemical compositions and their effects on the materials of construction. Of the chemical constituents identified, chlorides present the most troublesome element and, as a worse-case condition, are present at a concentration of 0.5 percent by weight. The primary conclusion of the corrosion evaluation is that none of the materials being stored should affect the integrity of the bin materials as long as they are kept dry. From a standpoint of uniform corrosion affects, the integrity of the bins is sound and the rate of material loss is expected to be negligible. This conclusion is supported by the results of INEEL efforts to evaluate the corrosion rate on sacrificial coupons removed from bins containing calcine. Two INEEL reports, reviewed by the corrosion engineer, concluded the corrosion that would be experienced during a 500-year design life is minimal based on the evaluation of retrieved corrosion coupons. This assumes, of course, the corrosion rate remains constant and uniform.

It was reported that the vault for Bin Set #1 contained water once, for a brief period during its active life (i.e., while calcine was being stored in the bins) as a result of a ruptured underground line. Though there is no evidence (see Section 3.5) to indicate such a condition ever existed, the corrosion engineer was asked to comment on potential corrosion concerns were any calcine to be present in the area outside the bins and inside the vault at the same time water/moisture was present. The primary corrosion concern under such a scenario would be the presence of wet chlorides which might cause pitting type corrosion on the outside of the stainless steel bins, and even stress corrosion cracking if stresses were involved. The potential for pitting corrosion

would be primarily in the Type-405 stainless steel, to some extent the Type-304, and to a lesser degree the Type-304L. However, there is no accurate way to predict the time to failure as a result of pitting and the corrosion allowance designed into the wall thickness of the bins would not be considered as a reliable line of defense in such a case. The evaluation of uniform corrosion as has been done in determining coupon corrosion rates is not applicable to pitting corrosion. There are limits on what can be concluded beyond these concerns; it is not possible to properly postulate the pitting potential of the bin materials under the hypothetical scenario.

3.4 TANK AGES

As indicated in Section 2, the seven Bin Sets were constructed over time as they were needed to provide storage capacity for the continuing production of calcine from the waste calcining operations. Table 4 provides a summary of the bin fabrication dates and the periods during which they were filled with calcine. The table also provides a brief description of the type of calcine (based on the type of liquid waste being treated) put into the bin and the calciner campaign(s) producing the calcine.

3.5 INTEGRITY EXAMINATION

As described in Table 1, the regulatory requirement for the integrity examination is that it be in the form of (1) a leak test, or (2) internal inspection that addresses cracks, leaks, corrosion, and erosion. The regulations also allow for alternate methods of achieving the latter requirement as long as it is capable of examining for the same tank features (or flaws). The use of the bins in the Bin Sets does not support any reasonable type of internal inspection. The highly radioactive nature of the material stored does not even support a visual inspection of the exterior of the bins, other than possibly by remote camera (and some limited external inspection has been done in this manner), and the non-liquid character of the waste does not support easy movement/removal of the material to allow interior inspections. Since the bins of Bin Set #7 are empty, this argument does not apply to those tanks, but they have never been used and there would be no reason to suspect cracks, leaks, corrosion, or erosion issues. It is the INEEL's position, however, that the radioactive nature of the material being stored in the bins does support an efficient means of

Table 4. Summary of bin fabrication dates and fill periods. [a]

Bin Set/Bin	Fabrication Date	Approximate Dates of filling actions (Mo/Yr) and Material Received
Bin Set #1		2/61 to 11/62 - cold testing calcine – later removed
VES-WCS-115-1	1959	11/63 to 12/63 - cold alumina start-up bed material 12/63 to 3/64 - aluminum calcine from WCF Campaign 1`
VES-WCS-115-2	1959	3/64 to 5/64 - aluminum calcine from WCF Campaign 1`
VES-WCS-115-3	1959	4/64 to 8/64 - aluminum calcine from WCF Campaign 1`
VES-WCS-115-4	1959	12/63 to 10/64 - aluminum calcine from WCF Campaign 1`
Bin Set #2		
VES-WCS-136-1	1965	8/68 to 10/71 - mostly zirconium calcine primarily from WCF Campaign 4
VES-WCS-136-2	1965	8/68 to 12/71 - mostly zirconium calcine primarily from WCF Campaigns 3 & 5
VES-WCS-136-3	1965	11/66 to 8/67 - mostly aluminum calcine from WCF Campaign 2
VES-WCS-136-4	1965	3/66 to 1/67 - mostly aluminum calcine from WCF Campaign 2
VES-WCS-136-5	1965	11/66 to 3/68 - aluminum and zirconium calcine from WCF Campaign 2
VES-WCS-136-6	1965	6/66 to 2/72 - mostly zirconium calcine from WCF Campaigns 2, 3, 4, & 5
VES-WCS-136-7	1965	6/66 to 6/69 - mostly zirconium calcine from WCF Campaign 3
Bin Set #3		
VES-WCS-140-1	1969	3/72 to 3/81 - mostly zirconium calcine primarily from WCF Campaign 9
VES-WCS-140-2	1969	3/72 to 3/80 - various types of calcine from WCF Campaigns 5, 6, 7, 8, & 9
VES-WCS-140-3	1969	3/72 to 7/79 - various types of calcine from WCF Campaigns 5, 6, 7, 8, & 9
VES-WCS-140-4	1969	3/72 to 9/79 - various types of calcine from WCF Campaigns 5, 6, 7, 8, & 9
VES-WCS-140-5	1969	3.72 to 3/78 - various types of calcine from WCF Campaigns 5, 6, 7, & 8
VES-WCS-140-6	1969	3/72 to 8/79 - various types of calcine from WCF Campaigns 5, 6, 7, 8, & 9
VES-WCS-140-7	1969	3/72 to 6/78 - various types of calcine from WCF Campaigns 5, 6, 7, & 8
Bin Set #4		
VES-WS4-142	1976	8/82 to 5/83 - zirconium and zirconium-sodium calcine from NWCF Campaign 1
VES-WS4-143	1976	8/82 to 7/83 - zirconium and zirconium-sodium calcine from NWCF Campaign 1
VES-WS4-144	1976	8/82 to 5/83 - zirconium and zirconium-sodium calcine from NWCF Campaign 1
Bin Set #5		
VES-WS5-146	1978	7/83 to 8/91 - various types of calcine from NWCF Campaigns 1, 2, & 3
VES-WS5-147	1978	Same
VES-WS5-148	1978	Same
VES-WS5-149	1978	Same
VES-WS5-150	1978	Same
VES-WS5-151	1978	Same
VES-WS5-152	1978	Same
Bin Set #6		
VES-WS6-154	1983 [b]	1/93 to 5/00 - various, but mostly sodium calcine from NWCF Campaigns 3 and 4
VES-WS6-155	1983	Same
VES-WS6-156	1983	Same
VES-WS6-157	1983	Same
VES-WS6-158	1983	Same
VES-WS6-159	1983	Same
VES-WS6-160	1983	Same
Bin Set #7		
VES-WS7-162	1985 [c]	Empty
VES-WS7-163	1985	Empty
VES-WS7-164	1985	Empty
VES-WS7-165	1985	Empty
VES-WS7-166	1985	Empty
VES-WS7-167	1985	Empty
VES-WS7-168	1985	Empty

a. Source: Staiger (1999) unless noted otherwise.
b. Source: Telephone conversation with M. Swenson (see Attachment C).
c. Age of Bin Set #7 bins is based on an April 1985 drawing ("7th Set Calcined Solids Storage Facility Bins," Drawing No. 165779) that contains as-built bin dimensions.

continuous leak testing. The remaining portion of this section addresses the INEEL's use of radiation monitoring for verifying the bins and their ancillary equipment are not leaking.

The Bin Sets include air ventilation to prevent build-up of the heat that results from the decay of the radioactive materials in the calcine. As part of the ventilation system, continuous air monitors (CAMs) are positioned in each of the Bin Sets to monitor air exhausted from the facility. These CAMs pull air through a filter that picks up particulate in the ventilation air and a detection instrument constantly measures any radioactivity collected on the filter. Any loss of containment (provided by the bins) would cause radioactive materials to be carried by the ventilation air and to be picked up by the CAMs. The following Technical Procedures were provided by the INEEL for review as a means of verifying the presence of the CAMs and of describing their operation:

- INTEC-TPR-P8.3-B1 (Revision 2, Effective Date: 6/26/01) - Solids Storage 1, 2, and 3, Operations
- INTEC-TPR-P8.3-B4 (Revision 3, Effective Date: 9/15/99) - Operate Solids Storage No. 4
- INTEC-TPR-P8.3-B5 (Revision 8, Effective Date: 3/29/00) - Operate Solids Storage No. 5
- INTEC-TPR-P8.3-B6 (Revision 12, Effective Date: 1/24/01) - Operate Calcine Solids Storage Facility No. 6
- INTEC-EAR-P8.3-Y1 (Revision 2, Effective Date: 11/02/00) - Respond to CAM and Sump Alarms at Solids Storage I, II, III, IV and V

Radiation detectors are capable of detecting very small quantities of radioactive materials. According to the last Technical Procedure identified above (i.e., INTEC-EAR-P8.3-Y1), the Bin Set CAMs are set to alarm at 5,000 counts per minute (cpm). Using several assumptions, simple calculations can be made (see the text box on the next page) to show that it would take only about 5 one-billionths (5×10^{-9}) of a pound of the calcine material to trigger the CAM alarm. At such a small amount, it is reasonable to assume that any release of calcine in the Bin Sets would cause enough to be picked up in the ventilation air to be detected by the CAM.

Estimate of the Amount of Calcine Needed to Trigger a CAM Alarm

Based on INEEL Technical Procedure INTEC-EAR-P8.3-Y1, the CAMs in the bin set facilities are set to alarm at 5,000 counts per minute (cpm). If it is assumed that the CAMs are only 10 percent efficient in counting radioactive disintegrations, there would have to be radioactive material present on the CAM air filter that provided 50,000 disintegrations per minute (dpm) to trigger the alarm. (This is taking no credit for contributions from background.) By definition, there are 2.2×10^{12} dpm per curie (Ci) of radioactive material. Accordingly, the CAMs are set to alarm if they reach:

$$(50{,}000 \text{ dpm}) / (2.2 \times 10^{12} \text{ dpm/Ci}) = 2.27 \times 10^{-8} \text{ Ci}$$

The bin sets contain varying amounts of activity, but based on the total activity and the volume of calcine, Bin Set #1 has the highest activity concentration of any of the bin sets. At a calculated total activity of 3.09×10^{6} Ci, at the start of the year 2016 and a total volume of 7,700 cubic feet (Staiger 1999), the activity concentration in Bin Set #1 would be about:

$$(3.09 \times 10^{6} \text{ Ci}) / (7{,}700 \text{ ft}^3) = 401 \text{ Ci/ft}^3$$

All that is needed to set the alarm (i.e., 2.27×10^{-8} Ci) is represented by a volume of:

$$(2.27 \times 10^{-8} \text{ Ci}) / (401 \text{ Ci/ft}^3) = 5.67 \times 10^{-11} \text{ ft}^3$$

At a density of 1.4 (Berreth 1988), this volume would weigh about:

$$(1.4)\ (62.4 \text{ lb/ft}^3)\ (5.67 \times 10^{-11} \text{ ft}^3) = 4.95 \times 10^{-9} \text{ lb}$$

Or about 5 one-billionths of a pound (about 2 micrograms), a very small number.

In addition to alarming at 5,000 cpm, the CAMs are routinely monitored and maintained, which includes the weekly collection of the air filters for a more detailed analysis than can be provided by the CAM. The analysis is performed for both gross alpha and gross beta activity. As part of the tank integrity assessment, six weeks of recent results from the analysis of the Bin Set CAMs were reviewed. The six weeks of data included computer printouts of numerous INTEC air sampling (CAM) stations identified by equipment/unit numbers. A key was also provided that linked the equipment numbers to facility locations so that the Bin Set CAMs could be located in the data. The equipment numbers also corresponded to numbers used in the Technical Procedures reviewed. The six weeks of data (August 20 and 28 and September 3, 10, 17, and 24

of 2002) are summarized in Table 5. It should be noted that the extremely small numbers [e.g., 10^{-15} micro curies per milliliter (μCi/ml)] are obtained by dividing the total count on the filters by the volume of air that passed through the filter over the week of measurement.

Table 5. Summary of Bin Set CAM filter analysis.

	Radiological Analysis Results (in μCi/ml)					
	Alpha		Beta		Average	
CAM Station	Low	High	Low	High	Alpha	Beta
Bin Set #1	1.7E-15	6.1E-15	2.1E-14	5.5E-14	2.9E-15	3.1E-14
Bin Set #2	2.5E-16	1.2E-15	1.2E-14	2.1E-14	6.9E-16	1.6E-14
Bin Set #3	1.5E-16	1.3E-15	2.0E-14	4.5E-14	7.1E-16	2.8E-14
Bin Set #4	0	7.8E-16	4.8E-15	1.2E-14	4.3E-16	8.8E-15
Bin Set #5	0	1.6E-15	3.2E-15	7.9E-15	7.0E-16	5.9E-15
Bin Set #6	0	9.9E-15	5.8E-16	2.9E-13	2.2E-15	6.2E-14

The data shown in Table 5 represent results of Bin Set air monitoring for only a limited period of time. However, it is reasonable to conclude that any loss or leak of calcine into the interstitial area where the ventilation air moves would result in continued CAM alarming and high filter counts as long as the material were present in that location. The individual performing this element of the tank integrity assessment was informed that the CAM results were continuously reviewed and there has never been readings that would indicate a leak of calcine from any of the bins. It was also noted that this does not mean that the CAMs have never alarmed. It is not unusual for the Bin Set CAMs or other site CAMs to occasionally provide false alarms. Whenever such an alarm occurs, response actions are taken to verify whether or not there is a release or some other type incident. The project participant was informed no Bin Set CAM alarm has ever been attributed to a leak or release of calcine from the bins.

It should be noted that there was evidence on drawings that the Bin Sets were required to be leak tested as part of specifications under which they were fabricated. However, results of these tests were neither provided to, nor pursued further by the assessment team. It is felt that such testing performed during vessel fabrication would not have met the regulatory requirement for a current integrity assessment.

4. SUMMARY ASSESSMENT

A summary of the manner in which tank integrity elements are met by the bins in Bin Sets #1 through #7 is presented in Table 6. The table presents the summary data according to the requirements' citation and designation as originally identified in Table 1.

The structural evaluation performed to address design standards resulted in some of the most significant findings presented in Table 6. Both the bins (or tanks by regulatory definition) in all seven Bin Sets and the seven vaults in which they are contained are considered to have adequate structural integrity with respect to normal and seismic loads using criteria from the 2000 IBC. Because of the high radiation fields associated with the Bin Sets, these conclusions are based solely on design drawings and reports provided by the INEEL (no site visit or first-hand observations were made of the structures).

Also of particular note is that no leak test or physical examination of the bins was performed as part of this assessment. The evaluator relied on records of radiological monitoring to reach the conclusion that the bins are not leaking. Though radiological monitoring is a very effective means of detecting any release of calcine, it does not provide any information as to whether or not there could be weak points in any of the tank systems. The design/structural and corrosion evaluations provide some assurance against the potential for weak points, but are not capable of identifying current, in-place conditions that might differ from the design and as-built information reviewed.

Table 6. Summary assessment for tank integrity elements.

Citation	Designation	Summary of Requirement Compliance
265.191(b)(1)	Design Standards	The stainless steel bins and the vaults in which they are contained were evaluated for their integrity based on normal and seismic loadings. The vaults and bins were found to have acceptable integrity based on criteria from 2000 IBC.
265.191(b)(2)	Waste Characteristics	Characterization information on the calcine material contained in the Bin Sets is presented in Tables 2 and 3 and is adequate for making a determination as to the waste's compatibility with the tank systems being assessed.
265.191(b)(3)	Corrosion Protection	The only corrosion control measure identified for the Bin Sets is the metallurgy, or selection of materials, used in the fabrication of the bins. The primary conclusion of the corrosion evaluation is that none of the materials being stored should affect the integrity of the bin materials as long as they are kept dry. From a standpoint of uniform corrosion affects, the integrity of the bins is sound and the rate of material loss is negligible.
265.191(b)(4)	Tank Age	Fabrication dates for the bins in each of the seven Bin Sets are provided in Table 4 and range from 1959 for those in Bin Set #1 to 1985 for those in Bin Set #7. All of the bins are young in comparison to their intended 500-year design life.
265.191(b)(5)	Integrity Examination	No leak test or physical examination of the bins was performed as part of this assessment. Results of radiological monitoring were reviewed as a means of verifying the current integrity of the bins.

5. CONDITIONS OF ATTESTATION

The hazardous waste tank systems evaluated for this registered professional engineering tank system integrity assessment, as required in 40 CFR 265.191, includes 42 stainless steel bins, or composite bins, located within 7 separate Bin Set vaults located at the INTEC. The following qualifications are a condition of the certification.

- Use of these tanks is limited to calcine material that is consistent with characterization data presented in this assessment.

- Design drawings and reports provided by the INEEL accurately reflect the as-built condition of the bins and the vaults in which they are contained.

- The bins or tank systems must be maintained in a dry condition (interior and exterior) to prevent the presence of wet chlorides that might cause pitting type corrosion of the stainless steel fabrication materials.

6. REFERENCES AND ATTACHMENTS OF CONFIRMATORY INFORMATION

6.1 REFERENCES

Berreth 1988 — Berreth, J.R., 1988. *Inventories and Properties of ICPP Calcined High-Level Waste*, WINCO-1050, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

DOE 2002 — DOE (Department of Energy) 2002, *Idaho High-Level Waste and Facilities Disposition Final Environmental Impact Statement*, DOE/EIS-0287, Idaho Falls, Idaho

Russell et al. 1998 — Russell, N.E., T.G. McDonald, J. Bannaee, C.M. Barnes, L.W. Fish, S.J. Losinski, H.K. Peterson, J.W. Sterbentz, D.R. Wenzel, 1998. *Waste Disposal Options Report*, Volume 2, INEEL/EXT-97-01145, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

Staiger 1999 — Staiger, M.D., 1999. *Calcine Waste Storage at the Idaho Nuclear Technology and Engineering Center*, INEEL/EXT-98-00455, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.

6.2 LIST OF ATTACHMENTS

Several documents key to this integrity assessment are included as attachments along with other supporting documentation. These attachments are identified as follows:

A. Structural Engineering Evaluation, Dyer Group LLC

B. Bin Set Integrity Assessment – Corrosion, Corrosion Control Specialist Inc.

C. Telephone Log

ATTACHMENT A

STRUCTURAL ENGINEERING EVALUATION

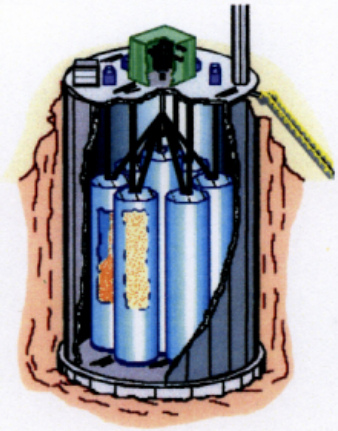
BY

DYER GROUP, LLC

STRUCTURAL ENGINEERING EVALUATION

CSSF Bin Set Storage Facilities 1-7

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY



Final Report

DYER GROUP LLC

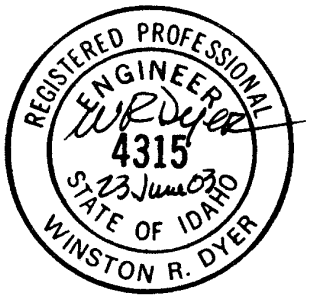
ENGINEERING • PLANNING • MANAGEMENT

208-656-8800

STRUCTURAL ENGINEERING EVALUATION

CSSF Bin Set Storage Facilities 1-7

IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY



Final Report
June 2003

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208-656-8800

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Appendix

Structure Data and Calculations

INTRODUCTION

Bin Sets 1 through 7 of the Calcined Solid Storage Facility (CSSF) are used to store spent radioactive material at the Idaho National Engineering and Environmental Laboratory (INEEL) site west of Idaho Falls. The radioactive material has been combined with calcium and other inert materials to form a granular substance that is easier to handle and store. The Bin Sets were constructed to facilitate handling of this material and provide for its safe, long-term storage. Figure 1 shows the typical configurations of Bin Sets 1-7 and provides an excellent visualization of the structures that are the subject of this report.

INEEL Site managers and the Idaho Department of Environmental Quality (IDEQ) carry the primary responsibility to see that the Bin Set storage facilities are properly operated and maintained. Accordingly, these entities monitor the ongoing condition and performance of the Bin Sets to assure the condition of the facilities is conducive to the environment and does not pose a threat to the health and welfare of the public.

As a part of this continual monitoring process, IDEQ and INEEL managers have considered federal government regulations requiring certain levels of due diligence with respect to the ongoing condition and operation of the CSSF hazardous waste facilities at the INEEL site. In particular, EPA regulations set forth in 40 CFR 265.191 state in part that an "... assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated to insure that it will not collapse, rupture, or fail..."

IDEQ officials have considered this regulation with respect to Bin Set condition and performance and have specifically requested that a new analysis be conducted to determine the status of the Bin Sets with respect to current building and structural codes. Since the structures were designed and constructed at various times over the last 40 years, and since such work was conducted in accordance with then prevailing building and structural codes, some of which have long since been updated, it was determined to take a new look at the structures with respect to current codes.

Modern building and structural codes have evolved through the years as greater knowledge has become available, experience with the results of earlier codes has been more thoroughly evaluated, and new technology has provided for more rigorous analysis. The overriding question is whether such additional code enhancements now available would suggest any improvements or modifications to the existing facilities to improve their safety and operation.

No amount of structural analysis can guarantee that a structure "... will not collapse, rupture, or fail..." under any or all conditions. However, in satisfaction of this federal regulation, it is possible to conduct a conservative initial analysis with simplifying assumptions ("threshold analysis") to develop an overall general picture of the present facilities with respect to current codes. Such examination will assist administrators and decision-makers to determine if there is a sufficient level of concern to warrant further, more detailed analysis.

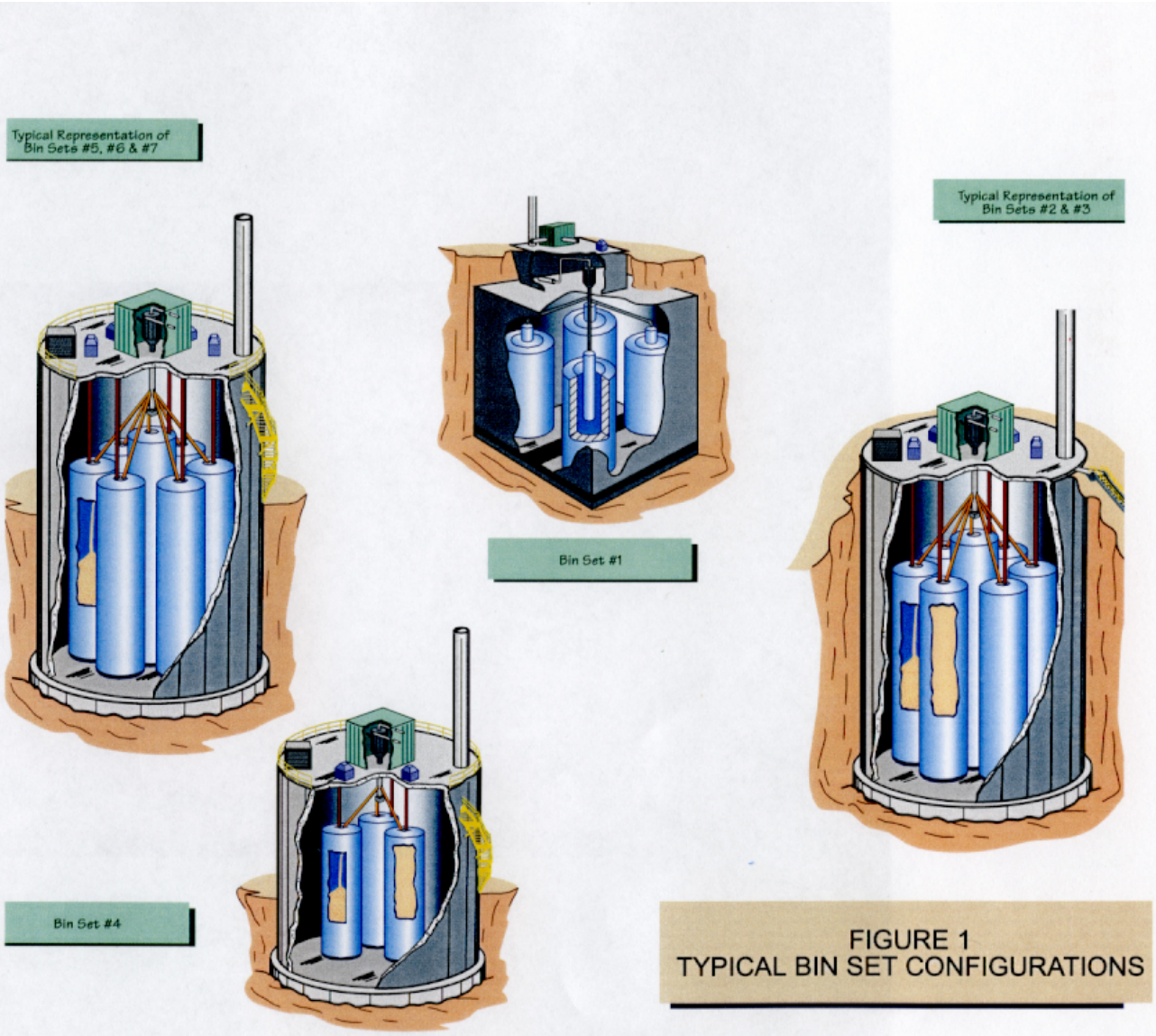


FIGURE 1
TYPICAL BIN SET CONFIGURATIONS

PURPOSE OF REPORT

The purpose of this report is to conduct and document a threshold structural analysis of the Bin Set structures with respect to current codes. Decision-makers can then decide if there are sufficient concerns to warrant a more in-depth analysis of any particular factor.

This report summarizes the approach and results arising from a structural analysis of the Bin Set structures with respect to current building codes. The analysis consisted of looking at the stainless steel bins containing the radioactive waste material and a separate look at the buried concrete vaults, which serve as a containment vessel for the stainless steel bins. In each case, analysis was made to identify structural response to normally expected, everyday loads and to seismic events reasonably predicted to occur at the INEEL site.

While state-of-the-art computer analysis techniques were employed where appropriate in conducting this threshold analysis, nevertheless simplifying assumptions were made where possible to keep the nature of the analysis to a reasonable budget and timeframe.

BIN SET BACKGROUND INFORMATION

Figure 1 provided an excellent overview of the nature of construction for Bin Sets 1-7. All of the bin set installations are similar in manner of construction. Each has a large concrete vault buried below ground (or partially below ground in some cases), inside of which individual stainless steel bins have been placed that serve as the actual storage vessels. The bins are freestanding and are secured to the floor of the concrete vault via anchor bolts around their lower perimeter.

The concrete vault for Bin Set No. 1 is square in cross-section and the remaining vaults are circular in cross-section. The concrete vaults have been excavated to a depth of 60-70 below the prevailing ground surface to where bedrock was encountered. The vaults are anchored to the bedrock via a concrete leveling slab and steel dowels.

Details of the stainless steel bins within the concrete vaults vary slightly with each bin set installation. The number of bins within a given vault varies from 3 to 7. The individual diameters range from 12.0 to 13.5 feet and heights of the bins range from 20.8 to 67.5 feet, with most sets being in the 53-67 foot range.

Bin Set No. 1 was constructed in the late 1950's and the other sets were constructed at various times over the succeeding 40 years.

PROJECT TEAM

The threshold analysis work for evaluating Bin Sets 1-7 with respect to modern building codes and updated seismic considerations was conducted by The Dyer Group, LLC. Winston R. Dyer, PE, Manager, is a registered professional structural engineer duly licensed and recognized by the State of Idaho to take responsible charge for such investigations.

For the purposes of this study, The Dyer Group is functioning as a subcontractor to Jason Associates Corporation, who in turn is under current contract directly to the INEEL site manager to assist with providing needed environmental information and related studies/analyses.

BUILDING CODE CONSIDERATIONS

The principal building codes approved and adopted by the State of Idaho include the Uniform Building Code (UBC) and the International Building Code (IBC). The UBC has been the governing code for the past half-century, being replaced by the IBC this year. Such codes are generally recognized by the industry as being an overall compilation of more specific, material-related building codes such as those issued by the American Concrete Institute (concrete structures) and the American Institute of Steel Construction (steel structures).

The UBC was first established in 1927 and has been regularly updated on a 3-5 year basis since that time. By the early 1960's, the code had a broad base of usage and contained state-of-the-art design information, including seismic considerations. While not specifically indicated on the construction drawings, it is highly likely that design of the CSSF Bin Set structures was governed either by the prevailing edition of the UBC at that time, or by the material-specific parent structural codes (ACI concrete and AISC steel) which the UBC would have incorporated.

Some innovations and refinements have been made to the codes through the years with respect to basic material properties and construction requirements. However, allowable stress and strain levels within structures under normally expected loadings have not changed significantly in the basic building code evolution over the past 3-4 decades. Consequently, it was expected that performance of the Bin Sets under normal, everyday loads would meet current building code standards.

Seismic considerations, on the other hand, have changed substantially from the benefit of additional data gathered during seismic events, greater understanding of the nature of seismic phenomena and corresponding structural responses, and substantially increased analytical capability provided by modern technology. Substantial increases (+33%) in seismic forces have been identified in building codes evolving over the past 2-3 decades. However, these have now been offset somewhat by a more rigorous, less conservative analysis of seismic forces allowed by the new IBC based on a vastly improved and expanded database of seismic site criteria throughout the country.

The end result was that a careful analysis of the Bin Sets needed to be made with respect to seismic forces predicted by the current building code, and the results obtained are a more accurate prediction of the likely performance of the structures during a seismic event than was ever before possible.

One last consideration with respect to building codes is in order. There is a general tendency among those outside the engineering and construction industry to expect that analysis of a given structure with respect to building codes is absolute and precisely predicts its expected behavior under the conditions being analyzed.

Such is clearly not the case. Uncertainties and inconsistencies with regard to site conditions, uniformity of materials, manner of construction, etc. have resulted in the building codes taking a more general approach to analysis and requiring adherence to certain factors of safety or probabilistic limits within the code. Analysis is then made either within a range of values or with safety factors employed to appropriately predict structural performance in response to various conditions to which the structure will be subjected over its design life.

Consequently, structural performance is predicted within a certain range of probability, but nothing is absolute. A given structure could experience failure long before predicted stress levels are reached if defective materials or workmanship is present, or may carry loads well in excess of predicted values under favorable circumstances. Thus, the key words in any analysis are, "... reasonably expected...".

ANALYSIS APPROACH

The structural evaluation of the CSSF Bin Sets 1-7 sought to conduct a threshold analysis of the concrete vault containment structures and the stainless steel bins within the vault structures. In general, the structural components were first examined with respect to normal, everyday loads such as earth pressure, self-weight, and stored contents. Then a second analysis was conducted subjecting the structural components to seismic forces predicted by application of current (IBC) building code requirements. The information that follows provides a more detailed review of the approach to analysis for this study.

Research: Archives were first researched to obtain copies of original drawings and previous studies that would provide information on the structures such as material properties, layout, dimensions, materials of construction, etc. Such information is necessary to properly understand the nature of the structure and correctly model it in the computer analysis programs. Pages 1-14 of the Appendix summarize design information gleaned from the available drawings for each Bin Set.

Simplifying Assumptions: To reduce the amount of required structural analysis to a manageable level, a general review was made by a structural engineer to compare various similar structures and identify those that would provide a "worst-case" result in

the analysis and eliminate the other non-governing or redundant structures. For example, the concrete vault in Bin Set No. 3 is larger in diameter than the No. 4 vault and would therefore provide a look at the worst-case for wall stresses.

Structures selected for analysis were then modeled for computer analysis. Here again, assumptions were necessary to simplify the modeling and to account for uncertain information in some cases. For example, bolt holes in the ring around the base of the stainless steel bins are slotted, which could allow expansion/contraction in response to temperature changes of the vessel. The degree to which the anchor bolt nuts are tightened will affect the amount of stress in the base of the bin. Conservative assumptions were made about the degree of fixicity ("fixed" as opposed to "sliding") to simplify the analysis.

Seismic Design Criteria: Computer analyses were then performed. The first analysis determined the seismic load factors to be applied based on the 2000 IBC (Appendix, page 15). The new code uses site information such as soil type and proximity to known faults, structure geometry, and importance criteria to predict an acceleration coefficient the structure will likely experience during a probable earthquake. In comparison to earlier codes (UBC), the 2000 IBC has an extremely intensive seismic database that breaks such seismic information down into a much smaller grid, providing substantially improved prediction of probability.

Site engineers had provided a more rigorous analysis for seismic design criteria to be used for structures at the Site. This was provided along with data for the individual structures. This correlated closely with predictions made by the 2000 IBC. Since this structural evaluation will eventually be submitted to State of Idaho authorities for review and approval, and since the 2000 IBC is the adopted State code, the 2000 IBC seismic design criteria were used in the analyses.

Earth Pressure: Earth pressure was next investigated (Appendix, page 18). Data was provided from Site personnel that included a soil study of the particular site where the bin sets are constructed. Specific information from that study was used in this structural evaluation to reflect soil conditions at the site.

Since the structures are buried to considerable depths in many cases, the Janssen formula was used to compute soil pressure on the buried structures. This is a more precise approach than using conventional earth pressure equations, and helps account for certain conditions expected to be associated with the considerable bury depth of the structures.

Here again, some simplifying assumptions were made, such as using linear analysis in lieu of the more costly and time-consuming non-linear analysis the Janssen equation allows. This assumption produced stress results that are likely to be higher than what the more rigorous analysis would produce. However, this is entirely appropriate for the "threshold" nature of this particular evaluation.

Analysis of Steel Bins: Steel bins were then analyzed by computer modeling and analysis (Appendix, pages 19-54). A necessary assumption was to assume that the bins are, or would be, completely filled (though most aren't at present) in order to identify the "worst-case" situation. Forces were developed taking into account the bin content (calcine), temperature (194 degrees Fahrenheit, max), self-weight, and seismic considerations.

The temperature loading represents the highest temperature recorded in a bin surface other than a brief heat transfer experiment conducted when cooling fans were shut off for a few weeks. Although interior calcine temperatures are significantly higher, the calcine material has a very low thermal conductivity. Therefore, it takes weeks for the higher interior temperatures to reach the bin surface, and then only if the cooling ventilation has been shut off that long.

Three different load combinations were developed to separately investigate the combination of content load, content plus seismic forces, and content plus temperature loading. Using these load combinations, specific investigation was made into the hoop and vertical bending stresses in the walls of the bins. The worst-case combination of the stresses is referred to as the Von Mises stress which was then compared to allowable stresses for the stainless steel material from the IBC.

Seismic forces analysis investigated the shear force at the base of the bins and the potential for overturning during an earthquake. This latter condition was addressed by examining tension on the anchor bolts that tied the bins to the concrete floor in a freestanding, cantilever situation (Appendix, pages 55-59). An additional analysis looked at possible local buckling of the bin wall plate near the base during a seismic event (which was included with the information presented on pages 19-54 of the Appendix).

To simplify the above analyses, the steel bins for Bin Set Nos. 2, 3, and 6 were analyzed, with bins for Nos. 1, 4 and 5, and 7 considered to be similar, respectively.

Analysis of Concrete Vaults: Finally, the concrete vaults were analyzed by computer modeling and analysis (Appendix, pages 60-109). Forces were developed taking into account earth pressure, self-weight, and seismic considerations. Load combinations were developed to separately investigate normal earth pressures and earth pressures plus seismic forces.

Using these load combinations, specific investigation was made into bending and shear stresses in the walls of the concrete vaults. Stresses were then compared to allowable stresses for the reinforced concrete as established by the IBC.

To simplify the above analyses, only vaults Nos. 1 and 3 were analyzed. Vault No. 1 is square in cross-section and is unique from all others. Vault No. 3 was considered to adequately represent conditions and expected results for vaults Nos. 2, 4, 5, 6, and 7. Reasons for selecting Vault No. 3 as the "worst-case condition" are as follows: Vault No. 2 is similar to Vault No. 3 and differences are negligible, Vault No. 4 is smaller and

not buried as deep as No. 3, and Vaults No. 5-7 are bigger but not buried as deep and the walls are twice as thick as No. 3.

DISCLAIMERS / QUALIFICATIONS

It is important for reviewers of this report to understand important factors affecting or limiting the accuracy of the results. To begin with, the analysis was conducted based solely on drawing information and reports about the facilities made available for review. No site visit was made and the structures have not in any way been inspected or reviewed on site by those responsible for conducting this analysis (security and safety reasons -- high radiation). Accordingly, no attempt could be made to verify that the structures were actually constructed per the information provided, or to determine the current condition of tank system components, other than reviewing some pictures of the interior of some vaults taken by remotely operated cameras.

Secondly, not all structures were evaluated. Similar structures were compared and analyzed to provide "worst-case" results for comparative purposes.

Lastly, this study is expressly intended to provide a "threshold analysis" which will establish a beginning point for decision-making about the results of analysis to see if further investigation is warranted. This evaluation provides a "snapshot" of current conditions with respect to reasonably expected performance predicted by current building code.

As earlier stated, no amount of structural engineering investigation or analysis can guarantee that a structure "... will not collapse, rupture, or fail..." under any or all conditions. What has been provided is a reasonable prediction of structural performance with respect to anticipated normal and seismic loads to which the structures may be subjected during their design life.

RESULTS OF ANALYSES

The following tables summarize results obtained from the analyses. Each Bin Set is listed along with the results obtained for the various conditions examined. Where an individual Bin Set was not specifically analyzed, reference is made to the results for a similar Bin Set that was analyzed instead. Such results are considered representative of the Bin Set that was not specifically analyzed.

CONCRETE VAULT WITHOUT SEISMIC FORCE				
Concrete Vault	**Vertical Rebar**	**Horizontal Rebar**	**Out of Plane Shear**	**In Plane Shear**
#1	Good	Good	Good	Good
#2	See #3	See #3	See #3	See #3
#3	Good	Good	Good	Good
#4	See #3	See #3	See #3	See #3
#5	See #3	See #3	See #3	See #3
#6	See #3	See #3	See #3	See #3
#7	See #3	See #3	See #3	See #3

CONCRETE VAULT WITH SEISMIC FORCE				
Concrete Vault	**Vertical Rebar**	**Horizontal Rebar**	**Out of Plane Shear**	**In Plane Shear**
#1	Good	Good	Good	Good
#2	See #3	See #3	See #3	See #3
#3	Good	Good	Good	Good
#4	See #3	See #3	See #3	See #3
#5	See #3	See #3	See #3	See #3
#6	See #3	See #3	See #3	See #3
#7	See #3	See #3	See #3	See #3

STEEL BIN WITHOUT SEISMIC FORCE		
Steel Bins	**Steel Thickness**	**Anchor Bolts**
#1	See #2	See #2
#2	Good	Good
#3	Good	Good
#4	See #3	See #3
#5	See #3	See #3
#6	Good	Good
#7	See #6	See #6

STEEL BIN WITH SEISMIC FORCE		
Steel Bins	**Steel Thickness**	**Anchor Bolts**
#1	See #2	See #2
#2	Good	Good
#3	Good	Good
#4	See #3	See #3
#5	See #3	See #3
#6	Good	Good
#7	See #6	See #6

Concrete Vaults: With respect to normal (non-seismic) loads, predicted stresses in all concrete vaults meet the provisions of the current 2000 IBC.

With respect to earthquake loads, predicted stresses in all concrete vaults appear to meet the provisions of the current 2000 IBC. Therefore, earthquake loadings will not be a problem for the concrete vaults of Bin Sets 1 through 7.

Stainless Steel Bins: All Bin Sets are acceptable with respect to normal (non-seismic) loads, including the temperature loading discussed earlier.

With respect to earthquake loads, all stainless steel bins for Bin Sets Nos. 1-7 are acceptable in relation to the 2000 IBC.

CONCLUSION

The concrete vaults and stainless steel bin structures comprising the CSSF Bin Set Storage Facilities 1-7 pass the threshold integrity assessment conducted, which was based on conservative assumptions. Since stresses in the structures meet current building code and no other structural concerns have been identified in the analysis, there is no need for further, more rigorous examination of any structure or component.

APPENDIX
Structural Analysis Results

Index of Calculations

Concrete Vault and Steel Bin Information.....1-14

Seismic Calculation (2000 IBC).....15-17

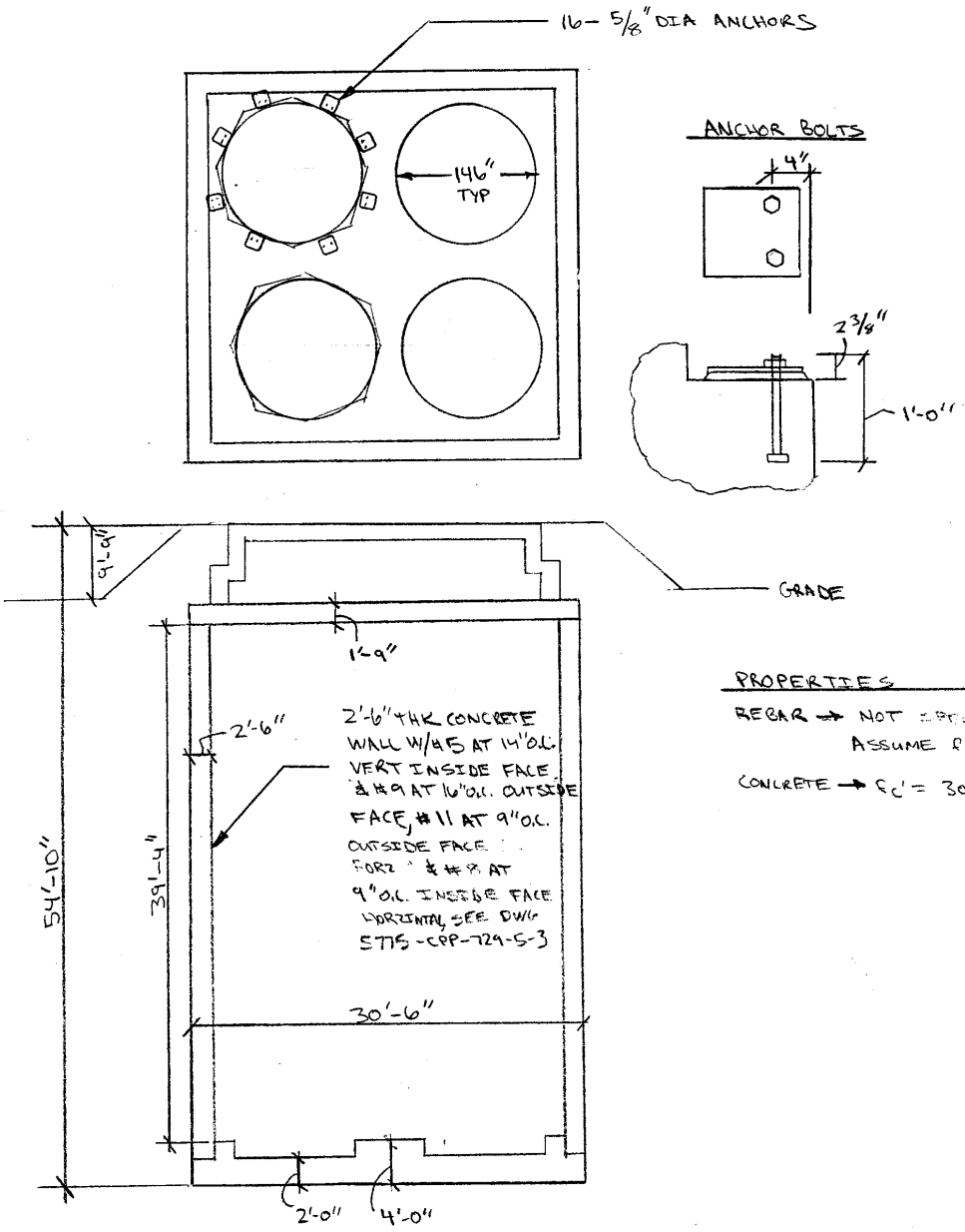
Janssen Equation (Ka= 0.5).....18

Steel Bin Check.....19-54

Anchor Bolt Check.....55-59

Concrete Vault Check.....60-109

BIN #1 (VAULT #1)



PROPERTIES

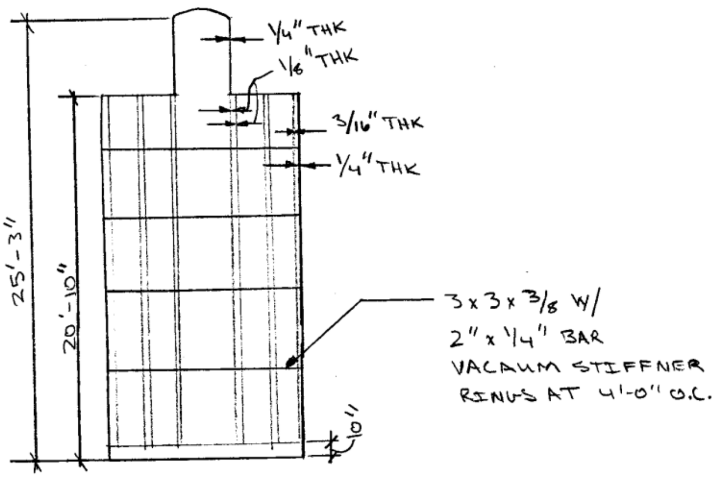
REBAR → NOT SPECIFIED
ASSUME f_y = 60 ksi

CONCRETE → f_c' = 3000 psi

Project Name:	Project #:	Initials:	Date:	Sheet: 1

BIN # 1

146" ø BIN (4)

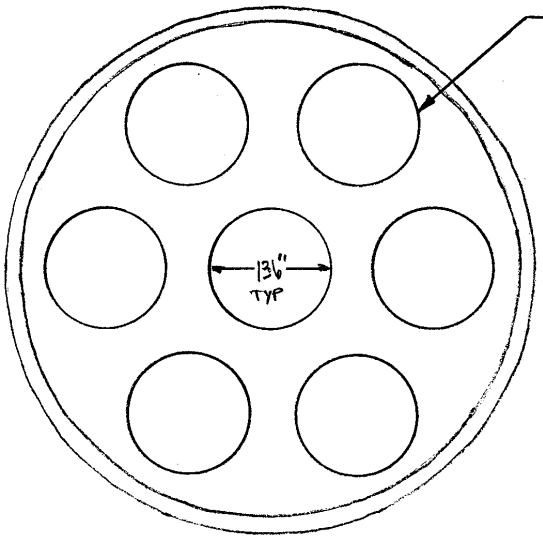


PROPERTIES

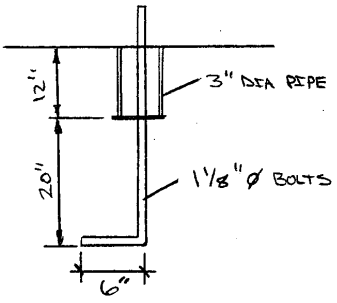
STEEL → ASTM - A7-57T

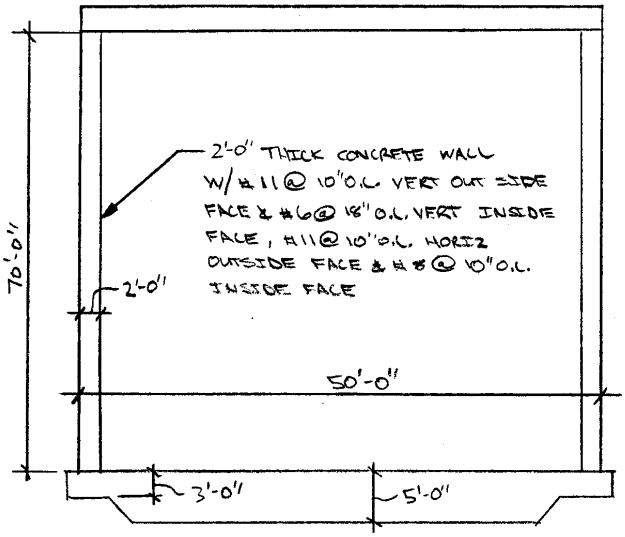
Project Name:	Project #:	Initials:	Date:	Sheet: 2

BIN #2 (VAULT #2)



ANCHOR BOLTS





PROPERTIES

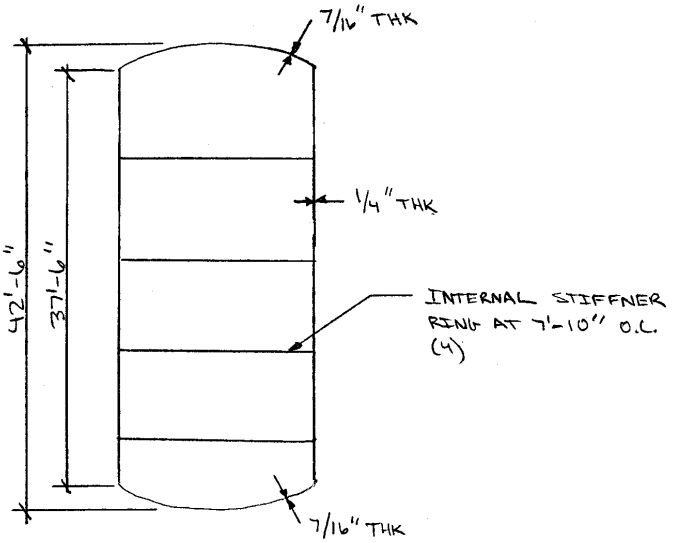
REBAR → INTERMEDIATE GRADE

CONCRETE → f'_c = 4,000psi

Project Name:	Project #:	Initials:	Date:	Sheet: 3

BIN # 2

144" ø BIN (7)

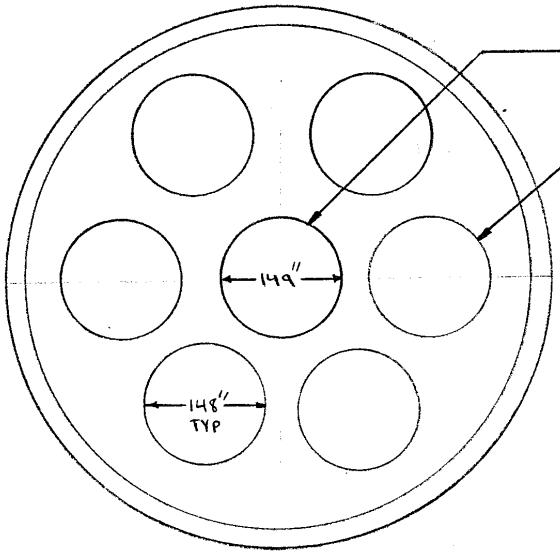


PROPERTIES

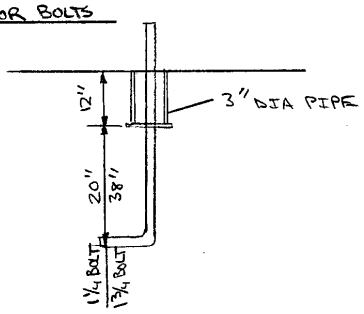
STEEL → NOT SPECIFIED

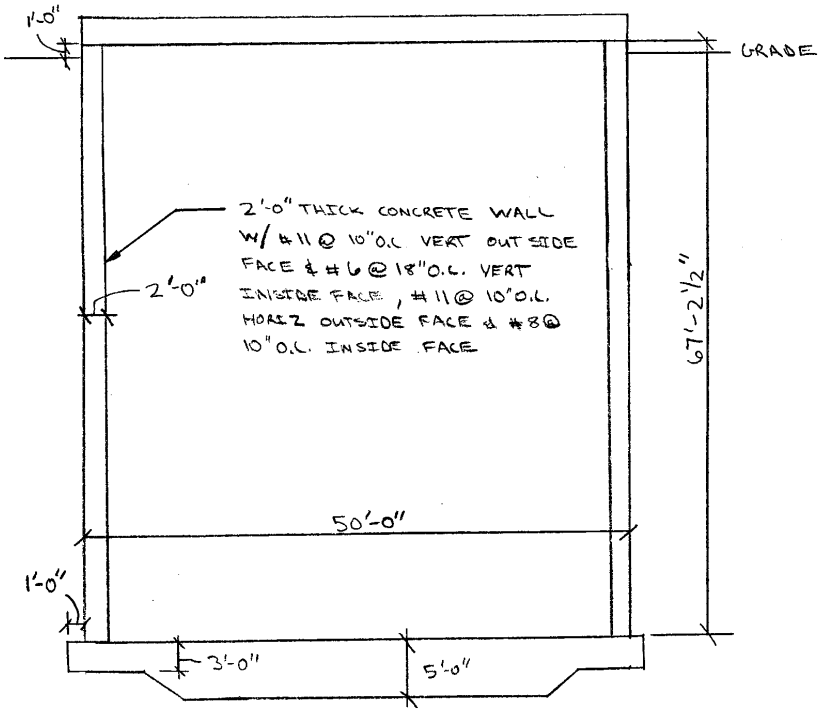
ASSUME A240-73 TYPE 304 (STAINLESS STEEL)

BIN # 3 (VAULT #3)



ANCHOR BOLTS





PROPERTIES

REBAR → INTERMEDIATE GRADE

CONCRETE → NOT SPECIFIED

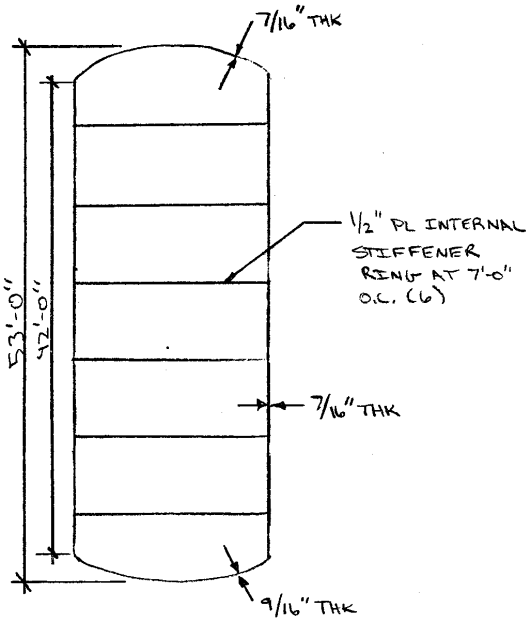
ASSUME f'_c = 3000 psi

(CLASS "A" CONCRETE)

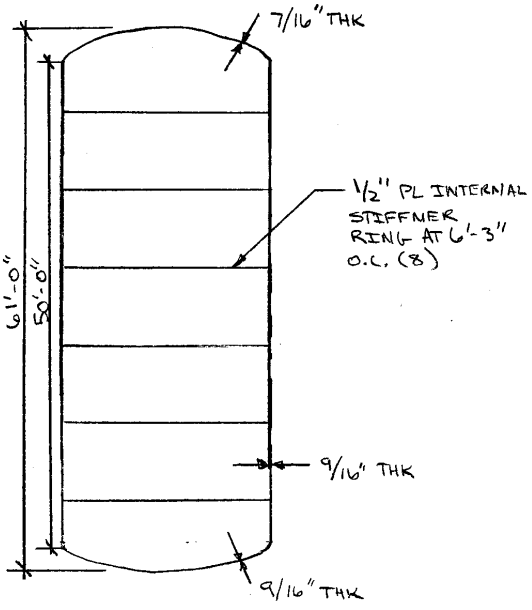
Project Name:	Project #:	Initials:	Date:	Sheet: 5

BIN #3

148"ø BIN (6)



149"ø BIN (1)

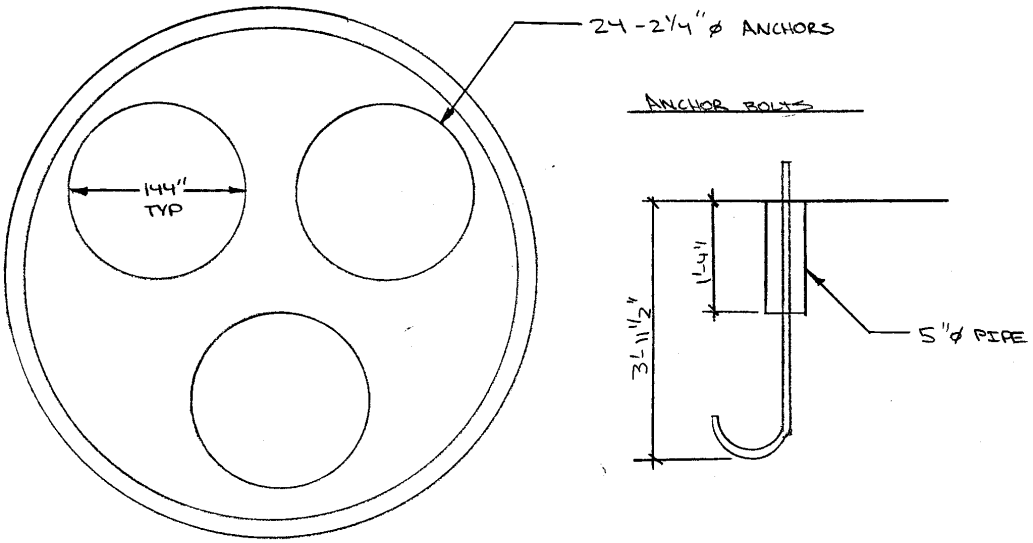


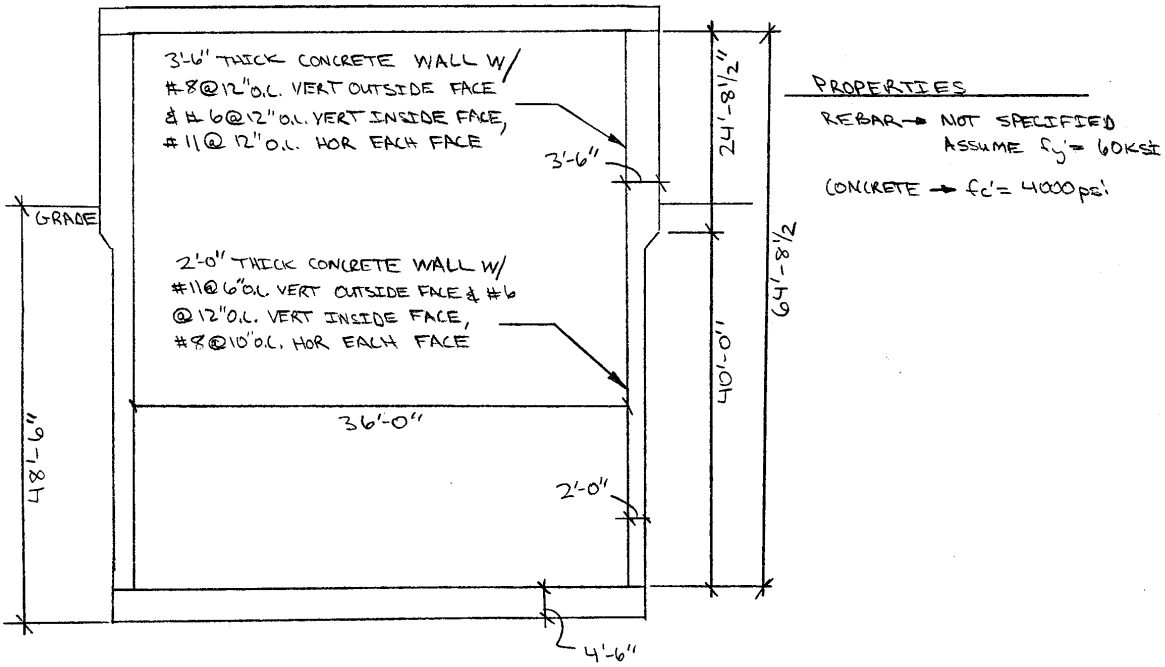
PROPERTIES

STEEL → A240-73 TYPE 304 (STAINLESS STEEL)

Project Name:	Project #:	Initials:	Date:	Sheet: 6

BIN #4 (VAULT #4)





PROPERTIES

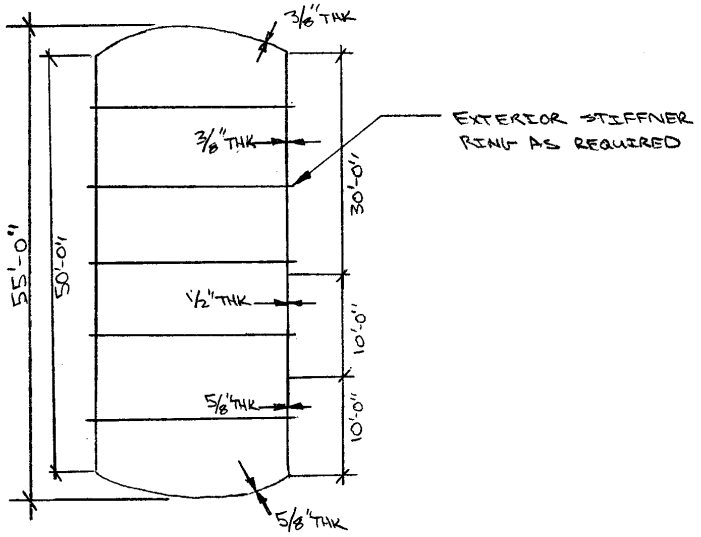
REBAR → NOT SPECIFIED
ASSUME f_y = 60KSI

CONCRETE → f_c' = 4000 psi

Project Name:	Project #:	Initials:	Date:	Sheet: 7

BIN # 4

144" ø BIN (3)

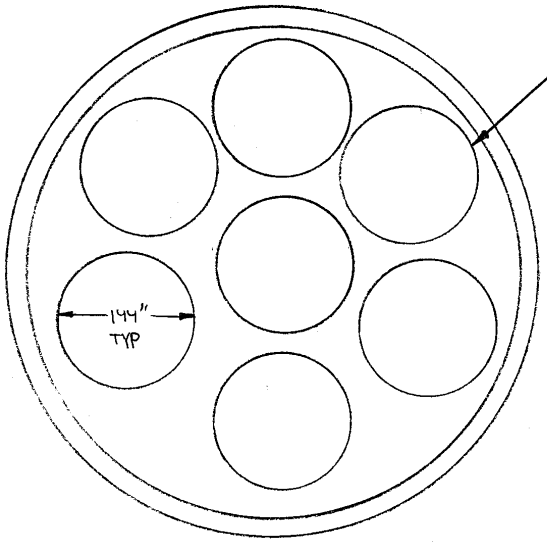


PROPERTIES

STEEL → A240-73 TYPE 304 (STAINLESS STEEL)

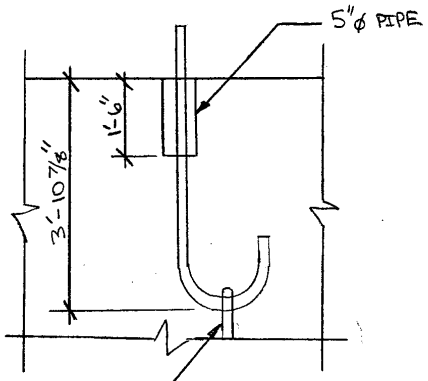
Project Name:	Project #:	Initials:	Date:	Sheet: 8

BIN # 5 (VAULT #5)

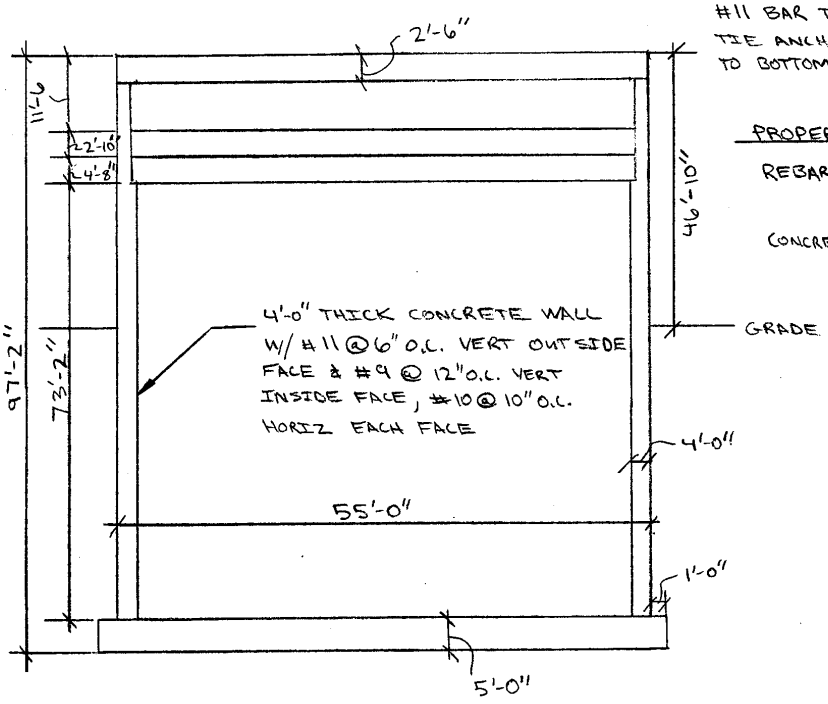


36 - 2 1/4" DIA ANCHORS

ANCHOR BOLTS



#11 BAR TO TIE ANCHOR BOLT TO BOTTOM REINFORCEMENT



PROPERTIES

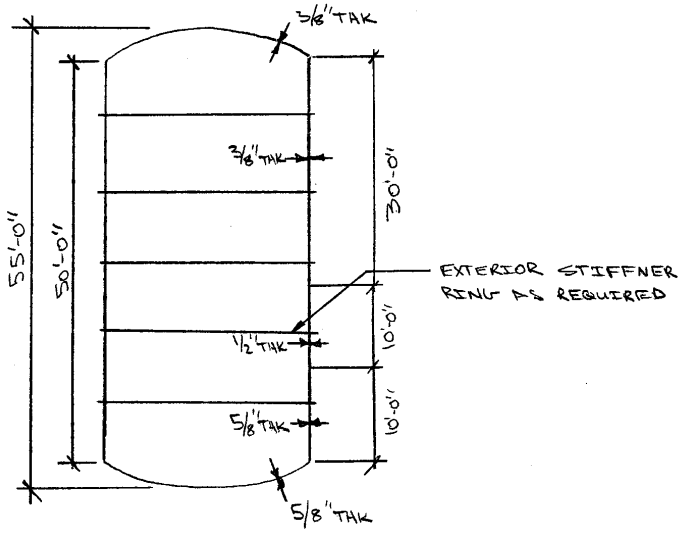
REBAR → NOT SPECIFIED
ASSUME f_y = 60 KSI

CONCRETE → f_c' = 4,000 psi

Project Name:	Project #:	Initials:	Date:	Sheet: 9

BIN # 5

144" ø BIN(7)

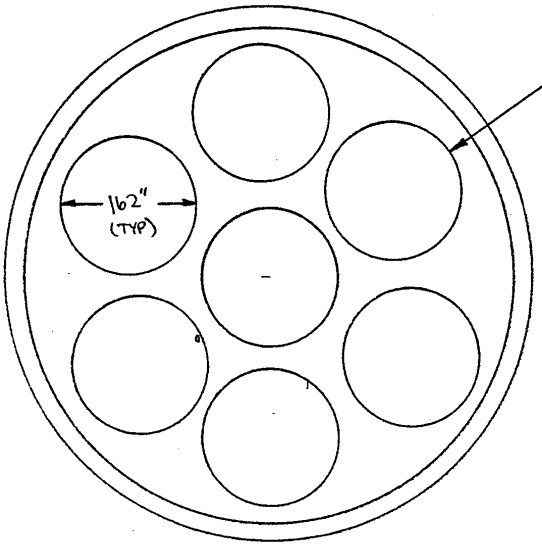


PROPERTIES

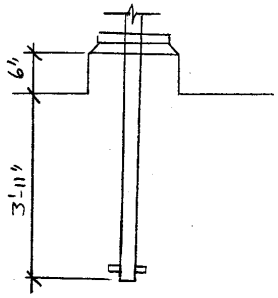
STEEL → TYPE 304L (STAINLESS STEEL)

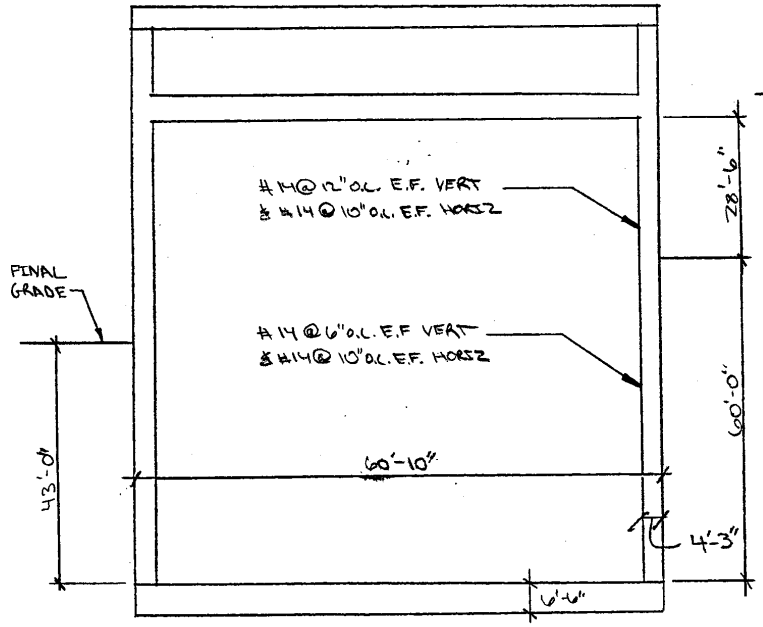
Project Name:	Project #:	Initials:	Date:	Sheet: 10

BIN #6 (VAULT #6)



ANCHOR BOLTS (SAME AS BIN #7)





PROPERTIES

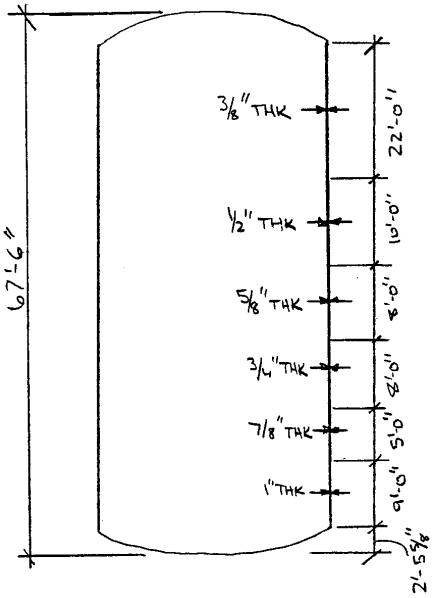
REAR → NOT SPECIFIED
ASSUME f_y = 60 ksi

CONCRETE → NOT SPECIFIED
ASSUME f_c = 3,000 psi

Project Name:	Project #:	Initials:	Date:	Sheet: 11

BIN #6

162" ø BIN (7)

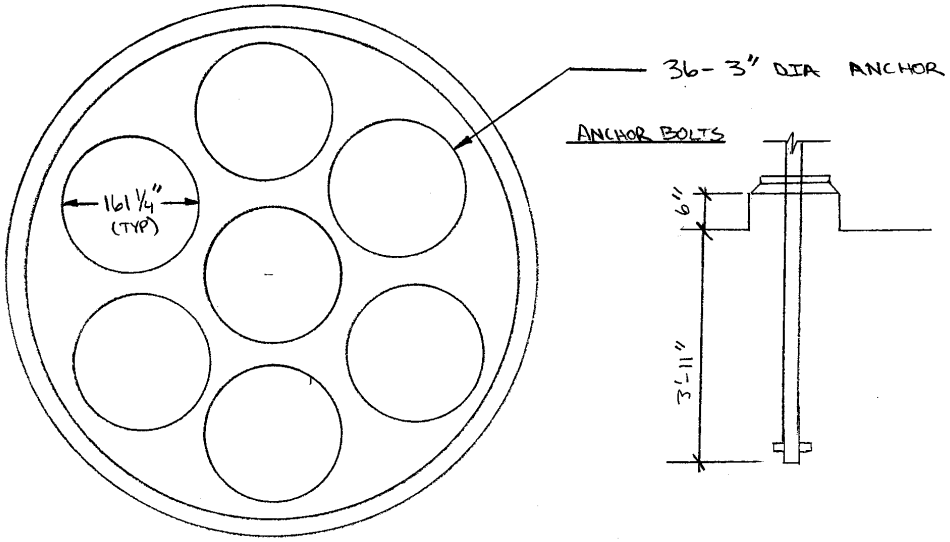


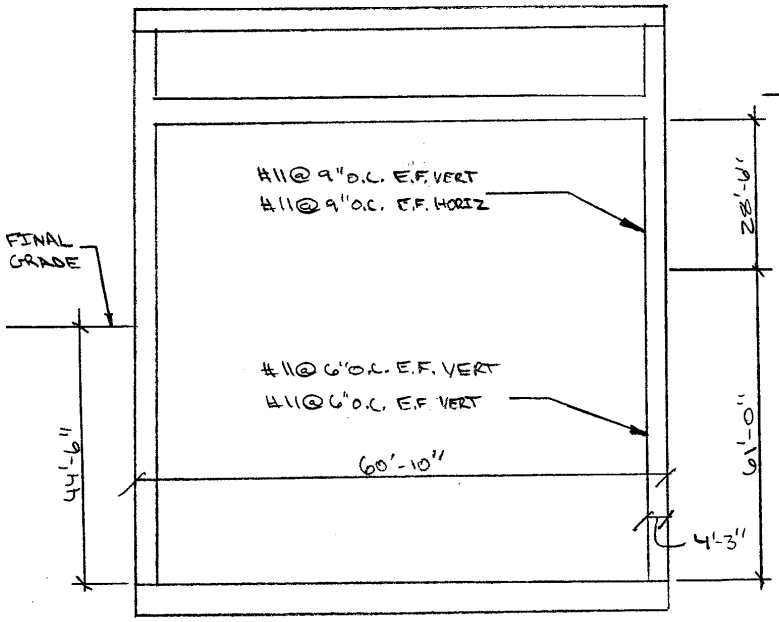
PROPERTIES

STEEL → TYPE 304L (STAINLESS STEEL)

Project Name:	Project #:	Initials:	Date:	Sheet: 12

BIN #7 (VAULT #7)





PROPERTIES

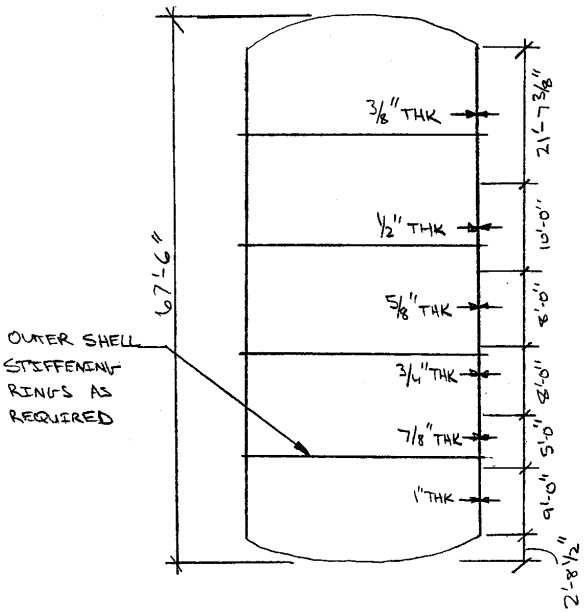
REBAR → NOT SPECIFIED
ASSUME f_y = 60ksi

CONCRETE → NOT SPECIFIED
ASSUME f_c = 3,000psi

Project Name:	Project #:	Initials:	Date:	Sheet: 13

BIN #7

161 1/4" ø BIN (7)



PROPERTIES

STEEL → TYPE 304L (STAINLESS STEEL)

Project Name:	Project #:	Initials:	Date:	Sheet: 14

INEEL SILO

MCE Ground Motion - Conterminous 48 States
Latitude = 43.5670, Longitude = -112.9330 ← LAT & LONG PROVIDED BY INEEL

Period (sec)	MCE Sa (%g)	
0.2	037.3	MCE Value of Ss, Site Class B
1.0	013.5	MCE Value of S1, Site Class B

Spectral Parameters for Site Class B

0.2	037.3	Sa = FaSs, Fa = 1.00
1.0	013.5	Sa = FvS1, Fv = 1.00

SEISMIC LATERAL ANALYSIS

2000 International Building Code
Equivalent Lateral Force Procedure

PROJECT NAME: Concrete Vault Design

V: C_sW		C_s: $S_{DS}/(R/I)$	
		C_s: $S_{DI}/(R/I)T$	(Max)
		C_s: $0.5S_1/(R/I)$	(Min, S_1equal or greater than .6 and in Seismic Category E or F)
		C_s: $0.044S_{DS}I$	(Min)

I_E (1604.5):	1.50	ap:	1	F_a:	1.00
Seis. Use Group (1604.5 & 1616.2):	III	R:	3	F_v:	1.00
Seis. Category (1616.3):	C	Ct:	0.02	S_{DS}:	0.2487
Site Class (1615.1.1):	B	acc (ultimate strength):	0.124	S_{DI}:	0.0900
S_S:	0.373	acc (service load):	0.087	T:	0.112 sec.
S_1:	0.135			Vbase:	0.0 k

CONCRETE VAULTS BEAR ON BED ROCK, SITE CLASS B WAS USED IN SEISMIC ANALYSIS.

SEISMIC LATERAL ANALYSIS

2000 International Building Code
Equivalent Lateral Force Procedure

PROJECT NAME: Steel Bin Design

V: C_sW

C_s: $S_{DS}/(R/I)$
C_s: $S_{DI}/(R/I)T$ (Max)
C_s: $0.5S_1/(R/I)$ (Min, S_1 equal or greater than .6 and in Seismic Category E or F)
C_s: $0.044S_{DS}I$ (Min)

I_E (1604.5):	1.50	ap:	1	F_a:	1.00
Seis. Use Group (1604.5 & 1616.2):	III	R:	3	F_v:	1.00
Seis. Category (1616.3):	C	Ct:	0.02	S_{DS}:	0.2487
Site Class (1615.1.1):	B	acc (ultimate strength):	0.124	S_{DI}:	0.0900
S_S:	0.373	acc (service load):	0.087	T:	0.112 sec.
S_1:	0.135			Vbase:	0.0 k

CONCRETE VAULTS BEAR ON BED ROCK, SITE CLASS B WAS USED IN SEISMIC ANALYSIS.

External fill on silos

USED FOR STEEL & CONC. BINS TYP.

$P = \gamma(0.5)H$

Bulk Density (pcf) $\gamma := 120$

Pile Height (ft) $z := 0, 2.5 .. 68$

Silo Diameter (ft) $D := 50$

Wall Friction Angle (deg) $\phi := 20deg$

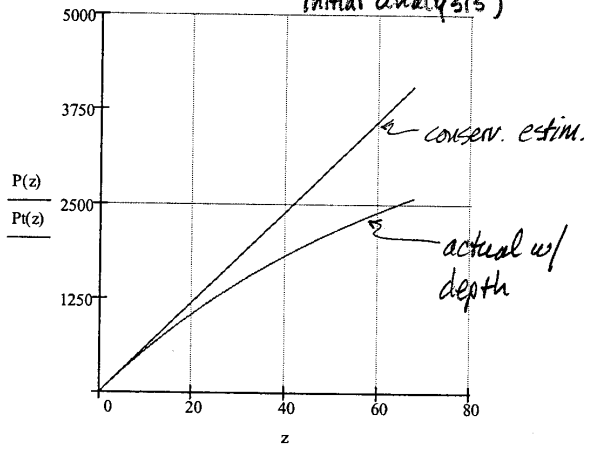
Friction Factor (ft) $\mu := \tan(\phi)$ $\mu = 0.364$

V/H Ratio (unitless) $K_j := .5$

Wall Pressure Janssen (psf) $P(z) := \frac{\gamma \cdot D}{4 \cdot \mu} \cdot \left(1 - e^{-4 \cdot \mu \cdot K_j \cdot \frac{z}{D}}\right)$

Wall Pressure Triangle (psf) $Pt(z) := .5 \cdot z \cdot \gamma$ → $K_j = .50$ (Janssen coeff, conserv. estimate [linear] for initial analysis)

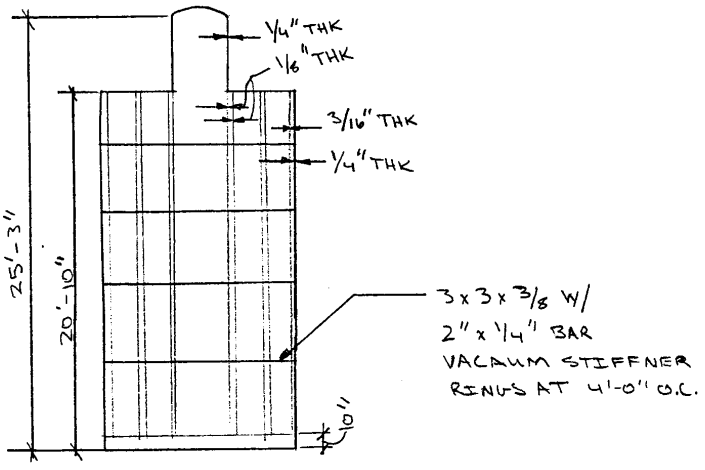
z =	P(z) =	Pt(z) =
0	0	0
2.5	147.303	150
5	289.341	300
7.5	426.302	450
10	558.368	600
12.5	685.714	750
15	808.508	900
17.5	926.912	$1.05 \cdot 10^3$
20	$1.041 \cdot 10^3$	$1.2 \cdot 10^3$
22.5	$1.151 \cdot 10^3$	$1.35 \cdot 10^3$
25	$1.257 \cdot 10^3$	$1.5 \cdot 10^3$
27.5	$1.36 \cdot 10^3$	$1.65 \cdot 10^3$
30	$1.458 \cdot 10^3$	$1.8 \cdot 10^3$
32.5	$1.554 \cdot 10^3$	$1.95 \cdot 10^3$
35	$1.645 \cdot 10^3$	$2.1 \cdot 10^3$
37.5	$1.734 \cdot 10^3$	$2.25 \cdot 10^3$
40	$1.819 \cdot 10^3$	$2.4 \cdot 10^3$
42.5	$1.901 \cdot 10^3$	$2.55 \cdot 10^3$
45	$1.981 \cdot 10^3$	$2.7 \cdot 10^3$
47.5	$2.057 \cdot 10^3$	$2.85 \cdot 10^3$
50	$2.131 \cdot 10^3$	$3 \cdot 10^3$



note: Janssen coefficient used as conservative value for loads on bins and vaults in initial analysis. Later replaced by 50 pcf equiv. earth pressure from site soils report.

BIN # 1

146" ø BIN (4)



PROPERTIES

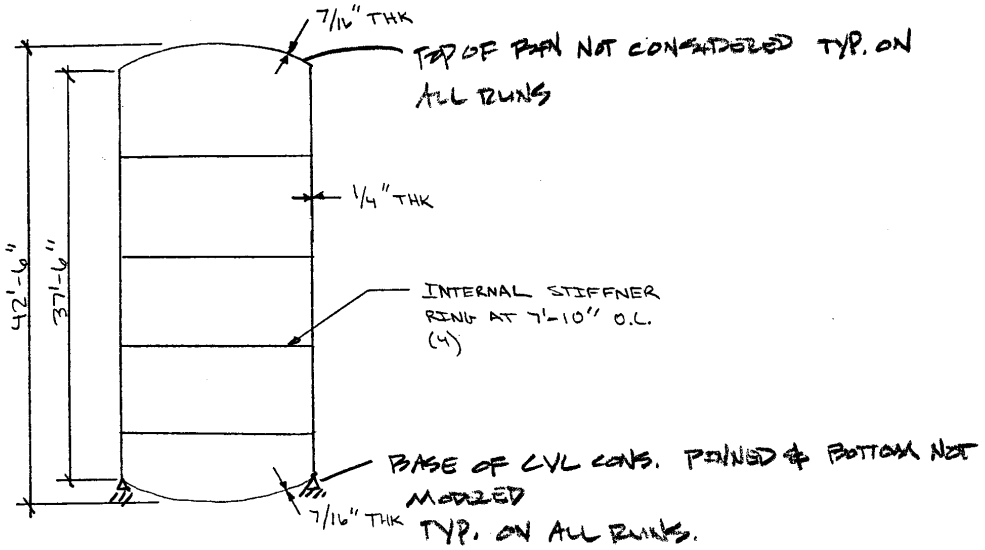
STEEL → ASTM - A7-57T

BIN #1 SIM. TO BIN #2 SEE CALCS FOR BIN #2

Project Name:	Project #:	Initials:	Date:	Sheet: 19

BIN # 2

144" ϕ BIN (7)



PROPERTIES

STEEL → NOT SPECIFIED

ASSUME A240-73 TYPE 304 (STAINLESS STEEL)

BIN#2 LOADING & ANALYSIS

LOAD CASE #1 DL + PL

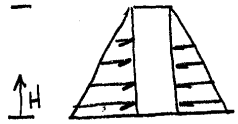
LOAD CASE #2 DL + PL + (S2) LOAD

Project Name:	Project #:	Initials:	Date:	Sheet: 20

BIN #2

- LOAD CASE #1 DL + PL

PL



SEE JANSEN EQ

$\gamma q_c H = P$

VON MISES STRESS = 7,914.5 psf 55.13 psi

YIELD = 33 ksi

ASSUME ALLOWABLE STRESS

$= F_y = 0.603(33\text{ksi}) = 19.9\text{ksf}$

19.9 > 5.5 ok

- LOAD CASE #2 SEE FOLLOWING PAGE FOR OVERTURNING FORCE

DL + PL + S2

U.M. = 3,015 psf 20.90 psi

19.9 > 2.1 + 5.5 ok

* NOTE THIS ASSUMES V.M STRESS WORST CASE FOR (DL+PL) ALIGNS W/ U.M. STRESS WORST CASE FOR (S2)

Project Name:	Project #:	Initials:	Date:	Sheet: 21

BIN #2

- LOAD CASE 3

  DL + PL + TL

- TEMPERATURE

  $T_{max} = 194°F$ (worst case @ normal operation per INEEL)

  $T_{normal} = 65°F$

  $\Delta T = 129°F$

- EXPANSION

  $\varepsilon @ 194°F = (6.1 + 0.0019t) \times 10^{-6} \qquad t = 194°F$

  $= 6.47 \times 10^{-6}$

  $D_{bin} = 144"$

  $Circum\ bin = \pi D = 452"$

  $\Delta L = \varepsilon t \ell = 6.47 \times 10^{-6} (129°) 452 = 0.38"$

- INDUCED STRESS

  $\Delta = \frac{P\ell}{AE} \rightarrow P = \frac{\Delta A E}{\ell} = \frac{0.38\ in\ (0.25 \times 12)\ in^2\ (28 \times 10^6)\ \frac{lb}{in^2}}{452\ in}$ ← 304 stainless

  $= 70.6\ kips$

  $\sigma = \frac{P}{A} = \frac{70.6}{0.25 \times 12} = 23.5\ ksi$

- TOTAL STRESS

  $\sigma_{DL+PL} = \frac{5.95 \times 10^5\ lb\ (1)\ ft^2\ (1)\ K}{ft^2\ 144\ in^2\ 1000\ lb} = 4.1\ ksi$

  $\sigma_{TOTAL} = 23.5 + 4.1 = 27.6\ ksi \leq 30\ ksi$ allowable for 304 SS, OK

Note: Stress reduced further if any sliding of base in slotted anchor holes occurs.

BIN #2

- SECOND ORDER EFFECTS

VERT BUCKLING OF BIN

ALLOWABLE STRESS PER KAMPS T. & J. LIEB
TECH PAPER No CBI 5460
1985 INT. J PRESS SOLIDS
MAY 1986

$$F_{a_{all}} = 1750\ t/R\left[1 + 50{,}000\,(t/R)^2\right] + \frac{0.15}{t}\sqrt{\frac{\sigma_i \times R}{E}} \times E \cdot \frac{t}{R}$$

$$F_{all} = 1750\ \frac{0.25''}{72''}\left[1 + 50000\left(\frac{0.25''}{72''}\right)^2\right] + \left[\frac{0.15}{0.25''}\sqrt{\frac{1.14 \times 72}{29000\text{ksi}}}\right] \times$$

$$29{,}000\text{ksi}\ \frac{0.25}{72''} = \underline{10.56\text{ksi}}$$

$$\sigma_i = R\gamma H g_c = \frac{120(.50)(36')\,72''}{144} = \underline{1140/_{IN}}$$

$$A_{ZG}\ F_a = -1.23E4\ \text{psf}\ \text{OR}\ 12300/_{12(.025)} = 4100\text{psi}$$

10.57 4.10 OK.

Project Name:	Project #:	Initials:	Date:	Sheet: 23

BIN # 2 VOL & SEISMIC FORCE CALC.

- 12'ϕ X 37'-6" TALL
* ASSUME FULL

$$VOL = 12'^2 \pi/4 \; 37.5 = 4241 \; FT^3$$

* ASSUME DENSITY 120 pcf

$$- MASS = 4241 \; FT^3 \; 120 \; lb/FT^3 = 509k$$

$$1000 lbs$$

* PER ACI 313 60% MASS IS TAKEN IN
- SEISMIC ANAL.

$$509 + 14k = 523k$$

(SILO MASS)

$$60\% = 523(.8) = 419k$$

- DETERMINE ACC ON STEEL TANK TO PROVIDE EQ MASS

$$\frac{X}{419} = \frac{32.2}{14} \qquad X = 9637 \; FT/S^2$$

USE AS LATERAL BODY FORCE

$$\text{SEISMIC ACC.} = (0.1087)\, 963 \; FT/S^2$$

$$= 83.8 \; FT/S^2$$

Project Name:	Project #:	Initials:	Date:	Sheet: 24

BIN # 2

PG(1) FEA

PG(2) GRANULAR LOADING @ FEA (120PCF)(0.5) SEE JANSEN CALC PAGE 18

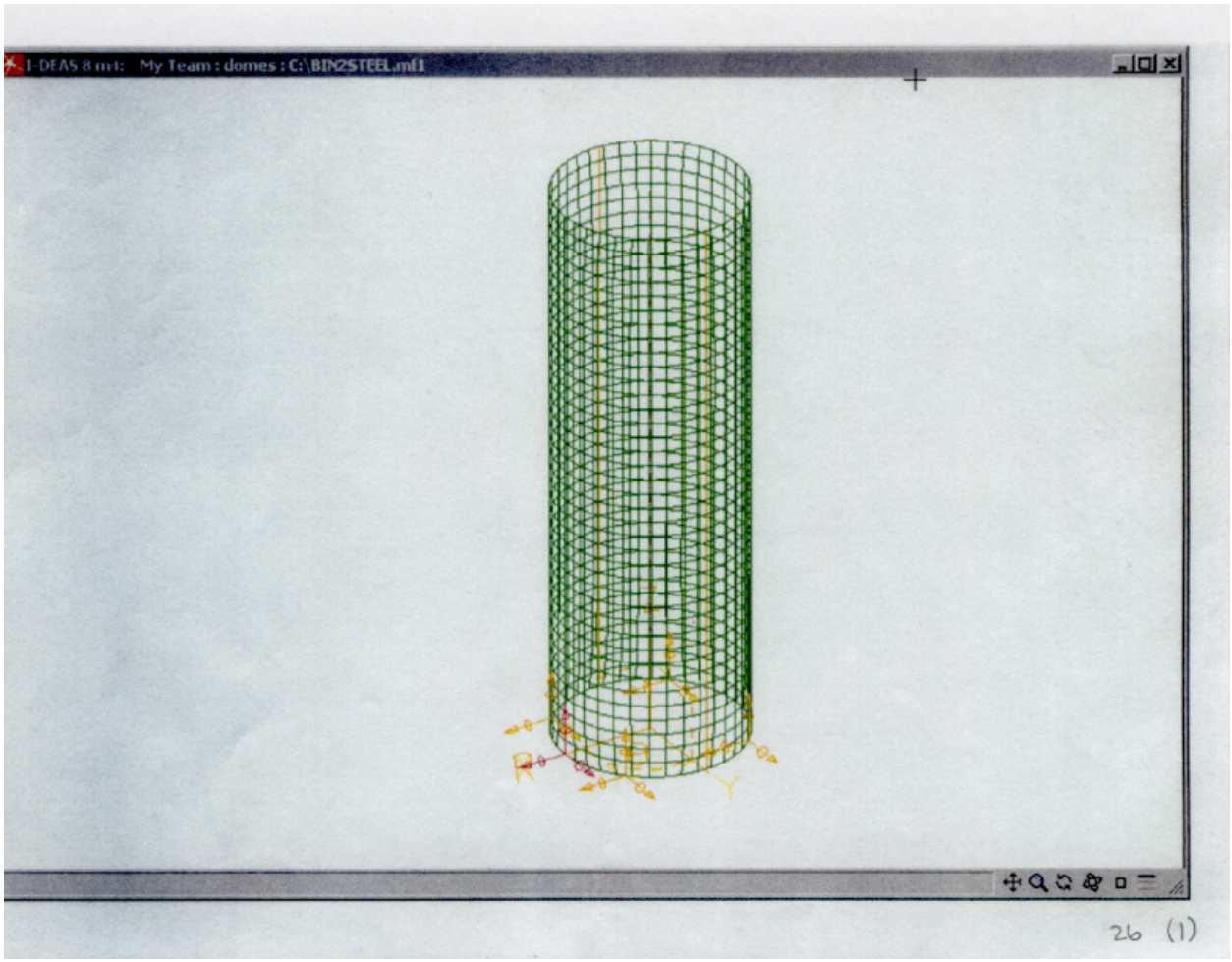
PG(3) VON MISES STRESS DL+PL (PSF)

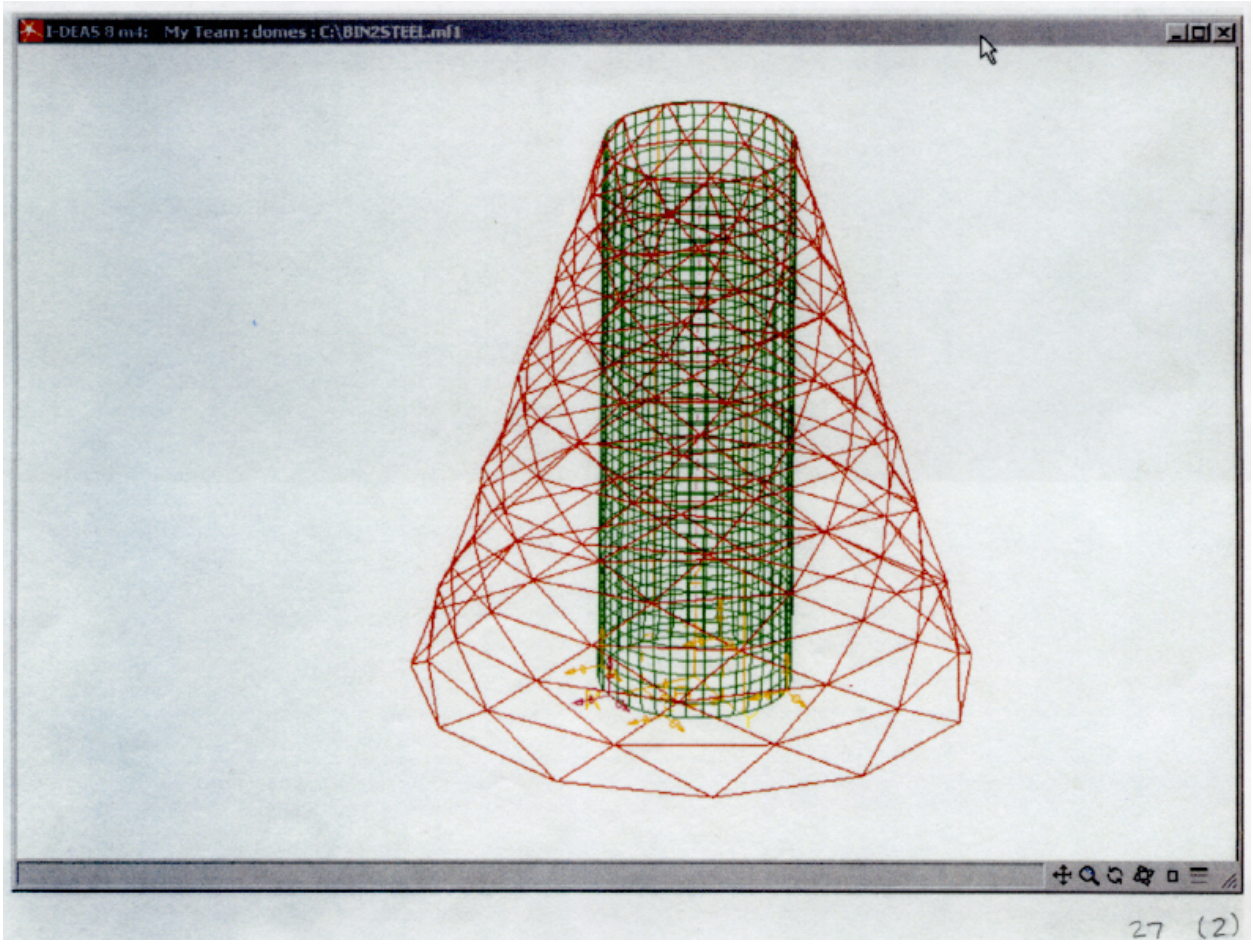
PG(4) VON MISES STRESS (S2) (PSF)

PG(5) REACTION FORCE (LB/FT)

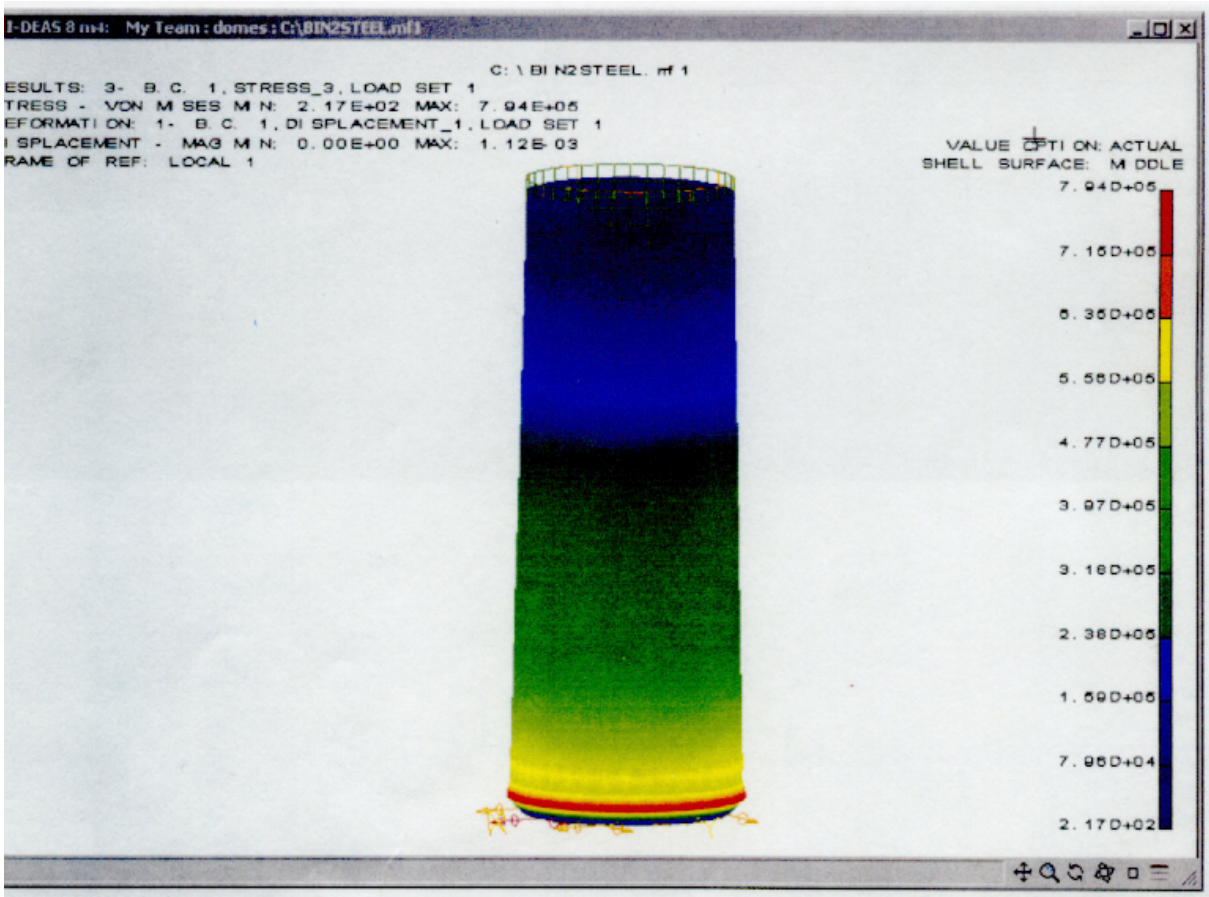
PG(6) VON MISES STRESS (TEMP)

Project Name:	Project #:	Initials:	Date:	Sheet: 25

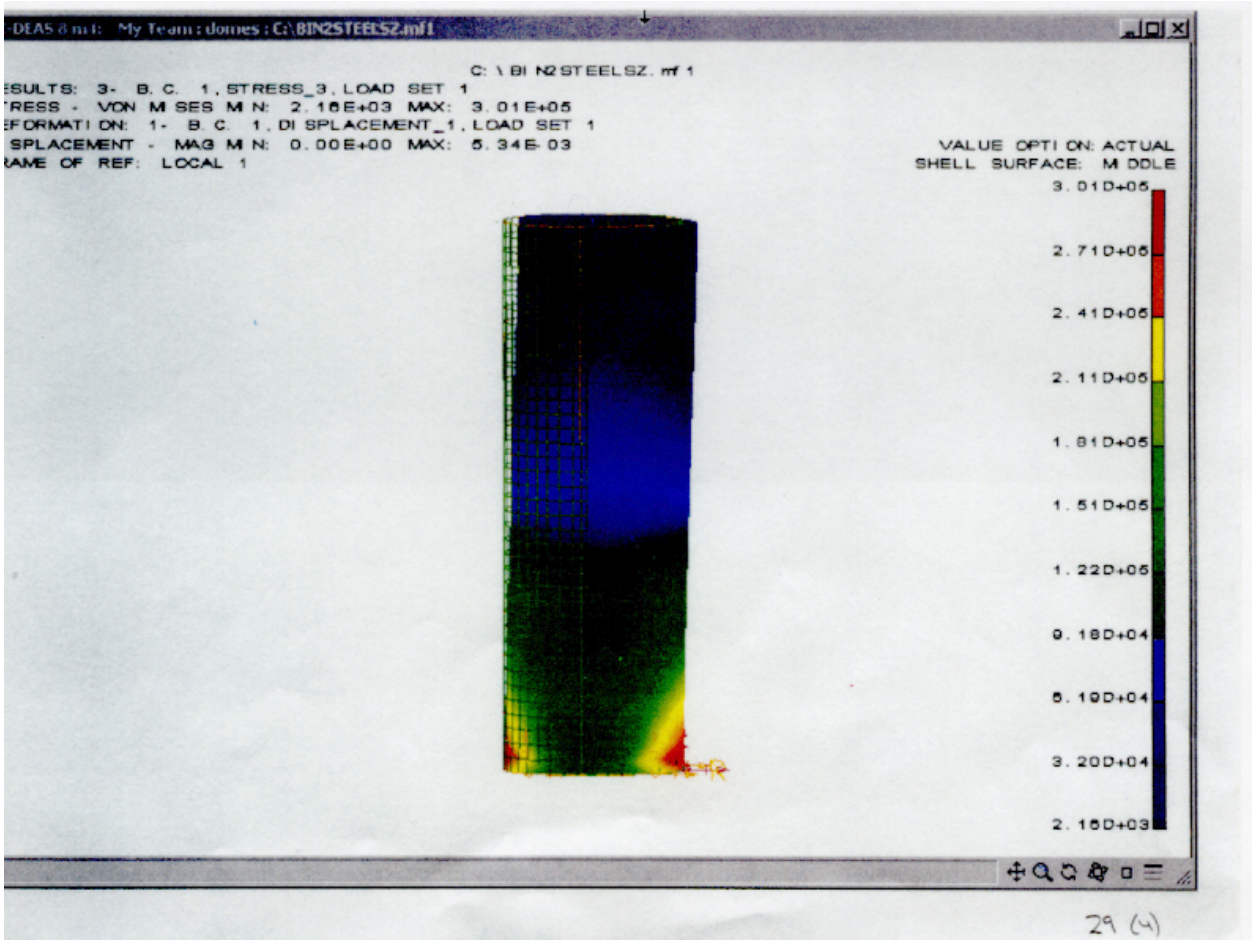

I-DEAS 8 m1: My Team : domes : C:\BIN2STEEL.mf1
R
Y

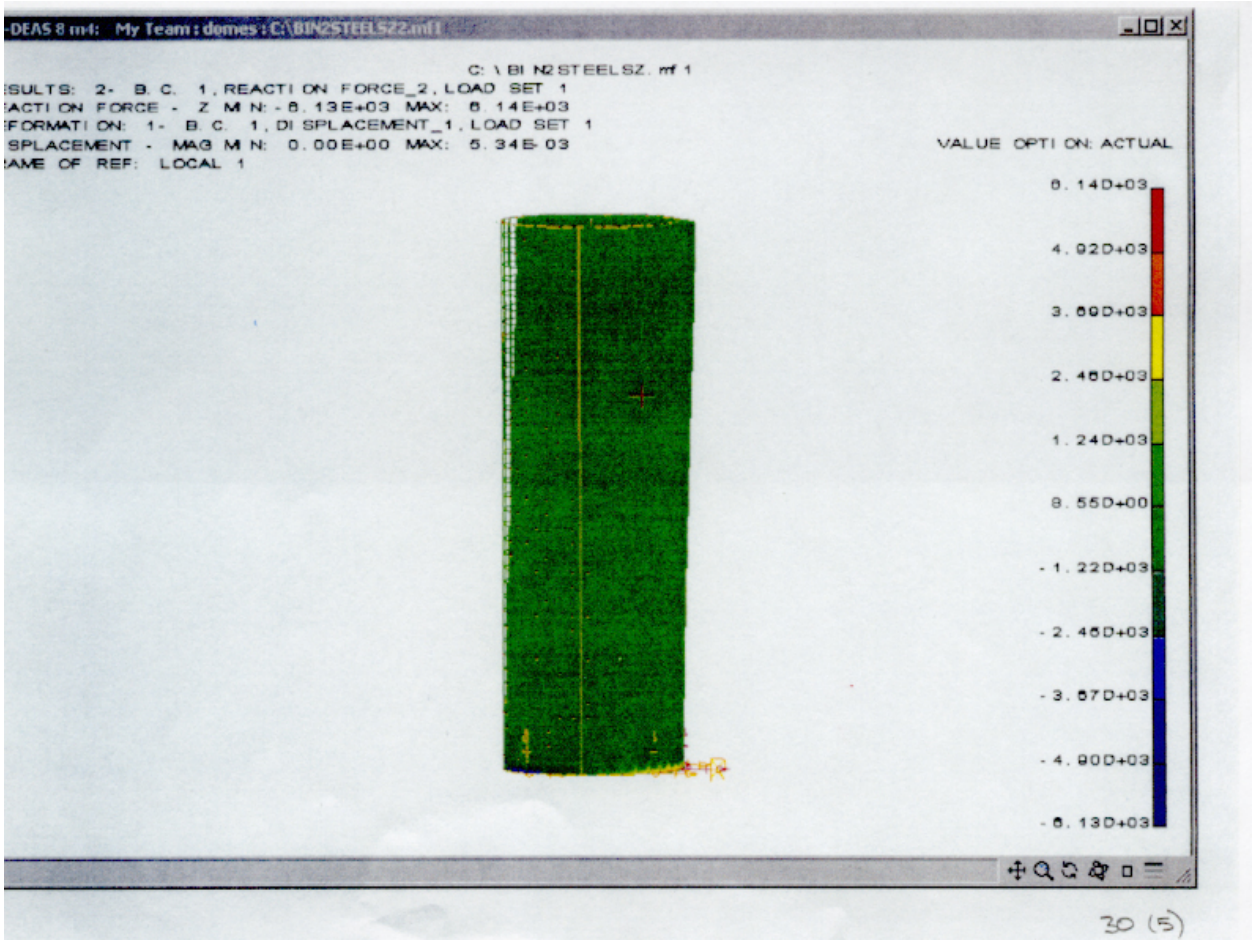


27 (2)

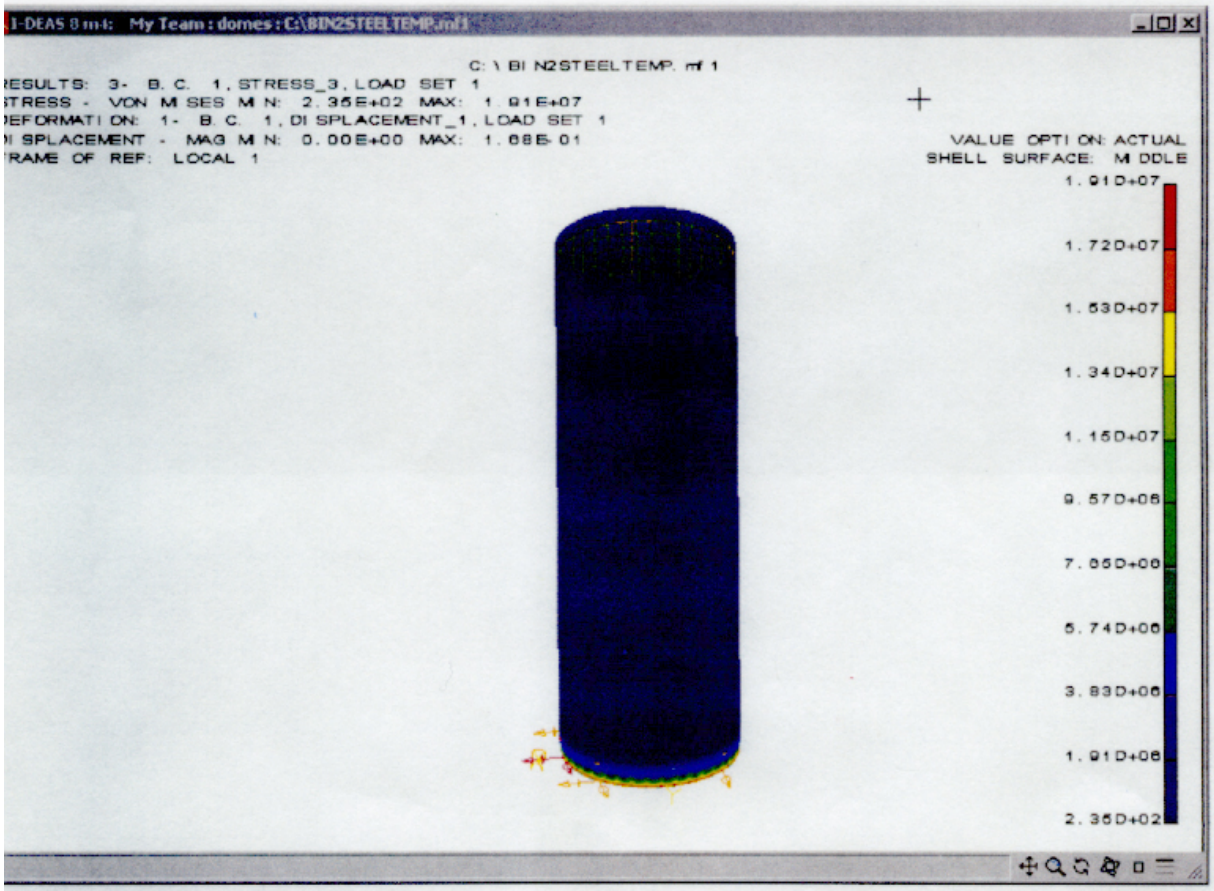

I-DEAS 8 m4: My Team : domes : C:\BIN2STEEL.mf1
C:\BIN2STEEL.mf1
ESULTS: 3- B.C. 1, STRESS_3, LOAD SET 1
TRESS - VON MISES MIN: 2.17E+02 MAX: 7.94E+05
EFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
ISPLACEMENT - MAG MIN: 0.00E+00 MAX: 1.12E-03
RAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
SHELL SURFACE: MIDDLE
7.94D+05
7.15D+05
6.35D+05
5.56D+05
4.77D+05
3.97D+05
3.18D+05
2.38D+05
1.59D+05
7.95D+04
2.17D+02

28 (3)


DEA5 8 m1: My Team : domes : C:\BIN2STEELSZ.mf1
C: \ BI N2 STEELSZ. mf 1
ESULTS: 3- B. C. 1, STRESS_3, LOAD SET 1
TRESS - VON MI SES MI N: 2. 16E+03 MAX: 3. 01E+05
EFORMATI ON: 1- B. C. 1, DI SPLACEMENT_1, LOAD SET 1
SPLACEMENT - MAG MI N: 0. 00E+00 MAX: 5. 34E-03
AME OF REF: LOCAL 1
VALUE OPTI ON: ACTUAL
SHELL SURFACE: MI DDLE
3. 01D+05
2. 71D+05
2. 41D+05
2. 11D+05
1. 81D+05
1. 51D+05
1. 22D+05
9. 18D+04
6. 19D+04
3. 20D+04
2. 15D+03

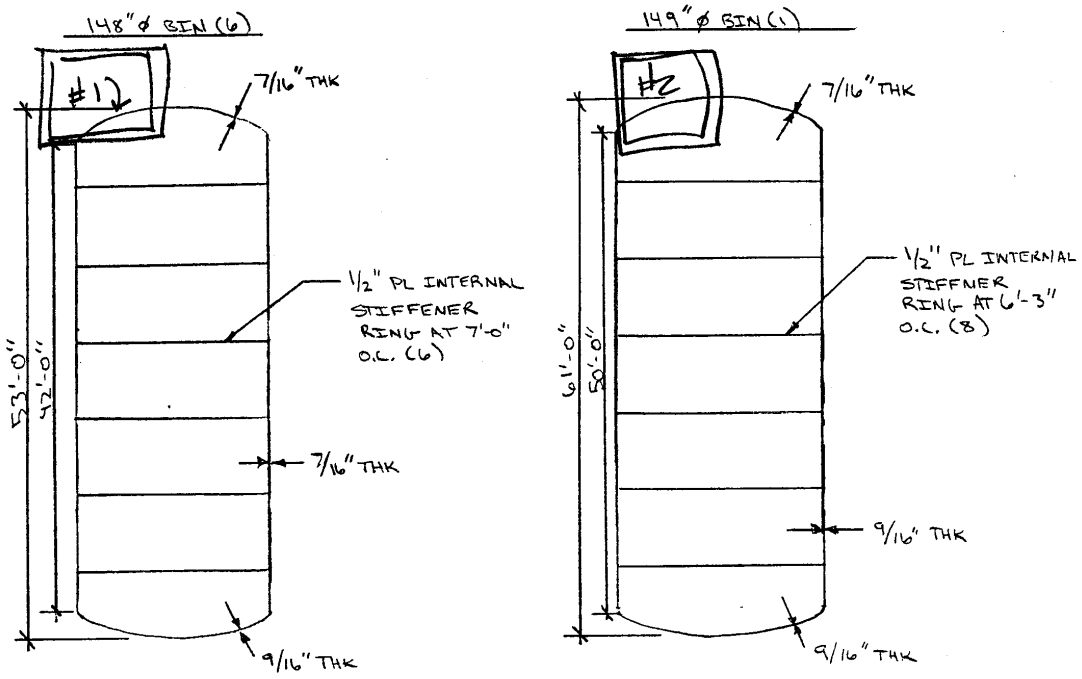

-DEAS 8 mf1: My Team : domes : C:\BIN2STEELSZ2.mf1
C: \ BI N2 STEELSZ. mf 1
ISULTS: 2- B. C. 1, REACTI ON FORCE_2, LOAD SET 1
ACTI ON FORCE - Z MI N: - 8. 13E+03 MAX: 8. 14E+03
FORMATI ON: 1- B. C. 1, DI SPLACEMENT_1, LOAD SET 1
SPLACEMENT - MAG MI N: 0. 00E+00 MAX: 5. 34E-03
AME OF REF: LOCAL 1
VALUE OPTI ON: ACTUAL
8. 14D+03
4. 02D+03
3. 69D+03
2. 46D+03
1. 24D+03
8. 55D+00
- 1. 22D+03
- 2. 46D+03
- 3. 67D+03
- 4. 90D+03
- 6. 13D+03

30 (5)


I-DEAS 8 m4: My Team : domes : C:\BIN2STEELTEMP.mf1
C: \ BI N2STEELTEMP. mf 1
RESULTS: 3- B. C. 1, STRESS_3, LOAD SET 1
STRESS - VON MI SES MI N: 2. 35E+02 MAX: 1. 91E+07
DEFORMATI ON: 1- B. C. 1, DI SPLACEMENT_1, LOAD SET 1
I SPLACEMENT - MAG MI N: 0. 00E+00 MAX: 1. 68E-01
FRAME OF REF: LOCAL 1
VALUE OPTI ON: ACTUAL
SHELL SURFACE: MI DDLE
1. 91D+07
1. 72D+07
1. 53D+07
1. 34D+07
1. 15D+07
9. 57D+06
7. 65D+06
5. 74D+06
3. 83D+06
1. 91D+06
2. 35D+02

31 (6)

BIN #3



PROPERTIES

STEEL → A240-73 TYPE 304 (STAINLESS STEEL)

BIN #3 CONSIDERED FOR BIN 3 #2 BIN 4 BIN 5
#1

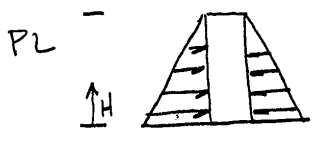
LOAD CASE 1 DL + PL

LOAD CASE 2 DL + PL + S2

Project Name:	Project #:	Initials:	Date:	Sheet: 32

BIN #3

-LOAD CASE #1 DL + PL



SEE JANSEN EQ

$\gamma q_c H = P$

VON MISES STRESS = 5.955 $\frac{ES}{psf}$ OR 4131.94 psi

YEILD = 33 KSI

ASSUME ALLOWABLE STRESS

$= F_y = 0.6(33ksi) = 19.8ksf$

19.8 > 4.1 ok

-LOAD CASE #2 SEE FOLLOWING PAGE FOR OVERTURNING FORCE

DL + PL + SZ

V.M. = 3.69 ESpsf OR 2563 psi

19.8 > 4.2 + 2.6 ok

*NOTE THIS ASSUMES V.M STRESS WORST CASE FOR (DL+PL) ALIGNS W/ V.M. STRESS WORST CASE FOR (SZ)

Project Name:	Project #:	Initials:	Date:	Sheet: 33

BIN #3

- SECOND ORDER EFFECTS

VERT BUCKLING OF BIN

ALLOWABLE STRESS PER KAMPS T. & J. LIEB
TECHPAPER No CB1 5460
1985 INT. J BULK SOLIDS
MAY 1986

$$F_{a_{all}} = 1750\ t/R\left[1 + 50{,}000\,(t/R)^2\right] + \frac{0.15}{t}\sqrt{\frac{\sigma_i \times R}{E}} \times E \cdot \frac{t}{R}$$

$t/R = 0.435''/74'' = 0.005912$

$1750\,(0.005912)\left[1 + 50\,000\,(0.005912)^2\right] = 28\text{ ksi}$

2ND TERM NOT NEED BY INSPECTION

$$28\text{ ksi} \gtrless \frac{21900\text{ lb/ft}}{.4375(12)} \text{ or } 417\text{ ksi}$$

OK

Project Name:	Project #:	Initials:	Date:	Sheet: 34

BIN #3 VOL & SEISMIC FORCE CALC.
SIM. TO BIN #2 CALC

- 12'Φ X 50' TALL 7/16" THK WALL

$$VOL = 12^2/4\ \pi\ 50 = \underline{5634\ FT^3}$$

$$MASS = \frac{5655(120)}{1000} = \underline{678.6\ K}$$

- SEISMIC ANAL.

$$80\% = (678.6 + \overbrace{33.5K}^{STRMASS})\ 0.8 = \underline{569K}$$

- DETERMIN ACC ON STEEL TANK TO PROVIDE EQ MASS

$$32.2/33.5 = \frac{X}{569} \quad X = 546.9\ FT/S^2$$

$$SEISMIC\ ACC = (0.087)\ 546.9\ FT/S^2$$

$$= 47.6\ FT/S^2$$

Project Name:	Project #:	Initials:	Date:	Sheet: 35

BIN #3

PG(1) FEA

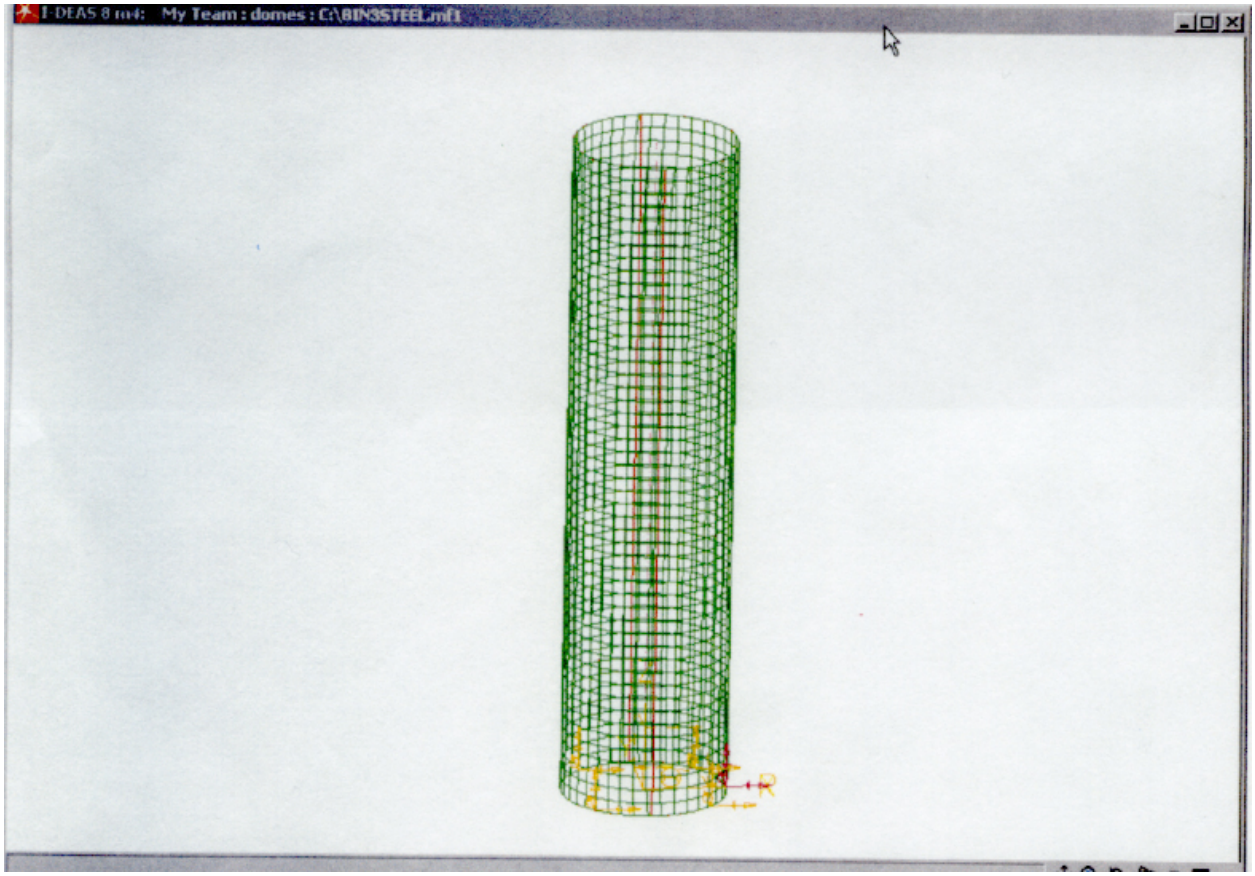
PG(2) GRANULAR LOADING & FEA (120PCF)(0.5) SEE JANSEN CALC PAGE 18

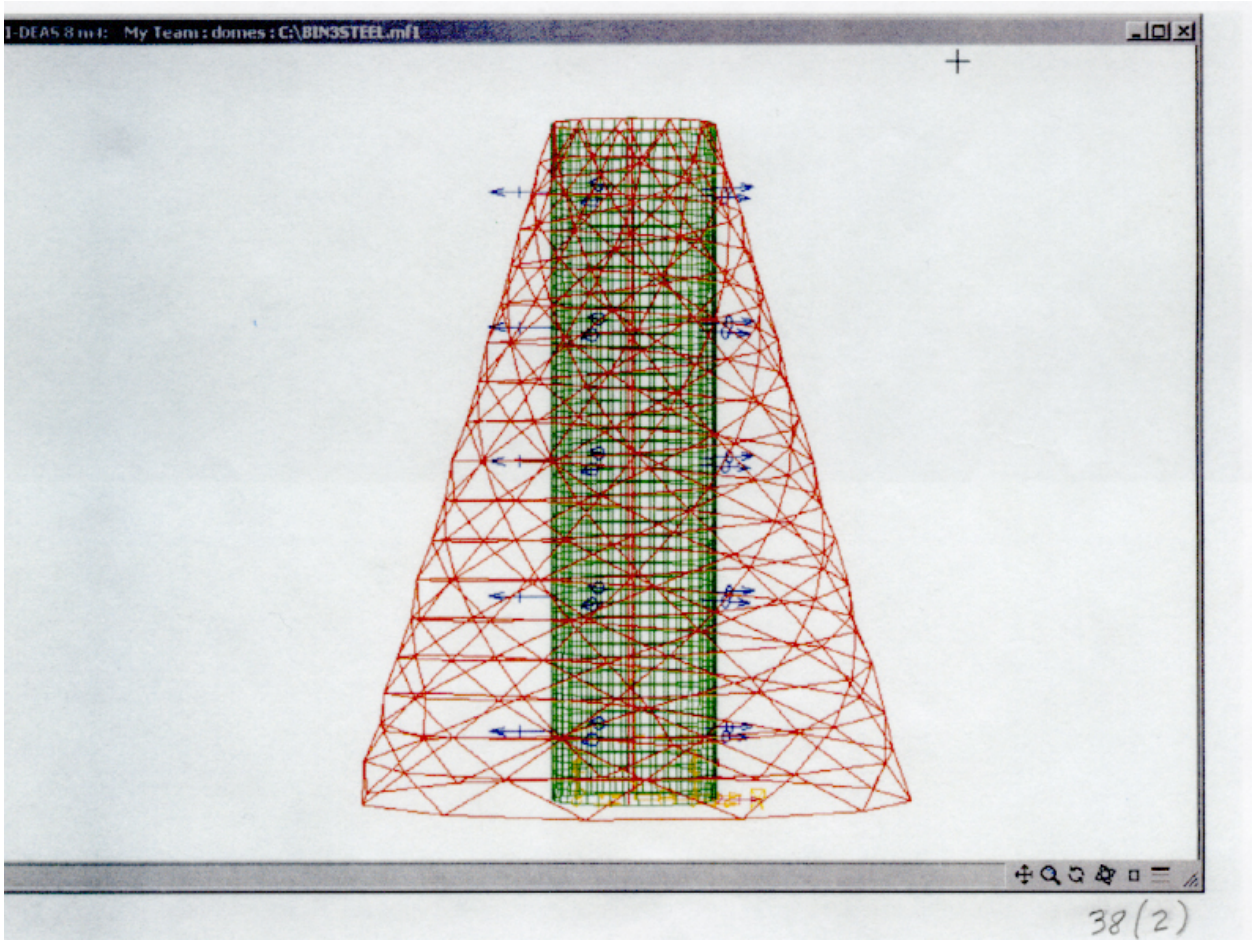
PG(3) VON MISES STRESS DL+PL (PSF)

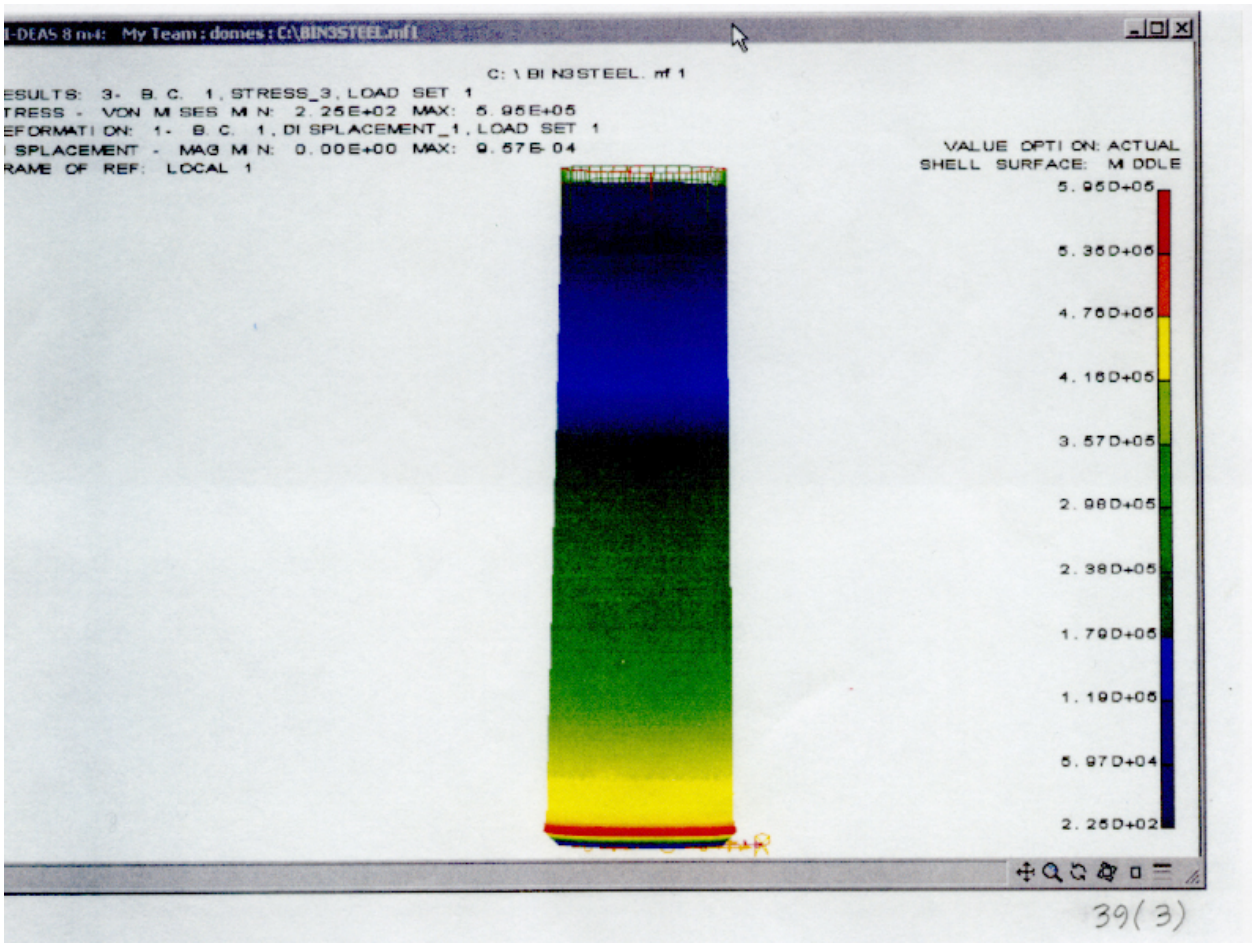
PG(4) VON MISES STRESS (SZ) (PSF)

PG(5) REACTION FORCE (LB/FT)

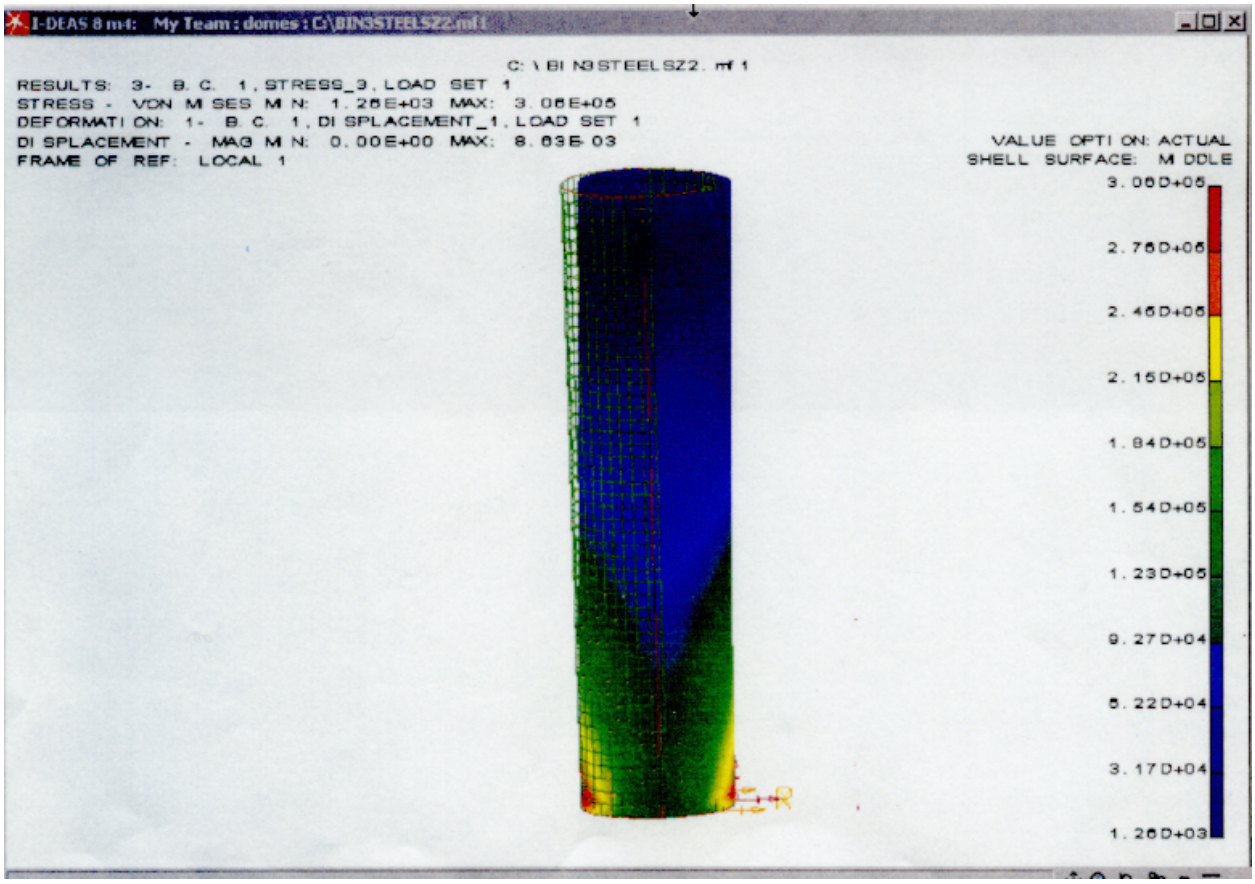
Project Name:	Project #:	Initials:	Date:	Sheet: 36

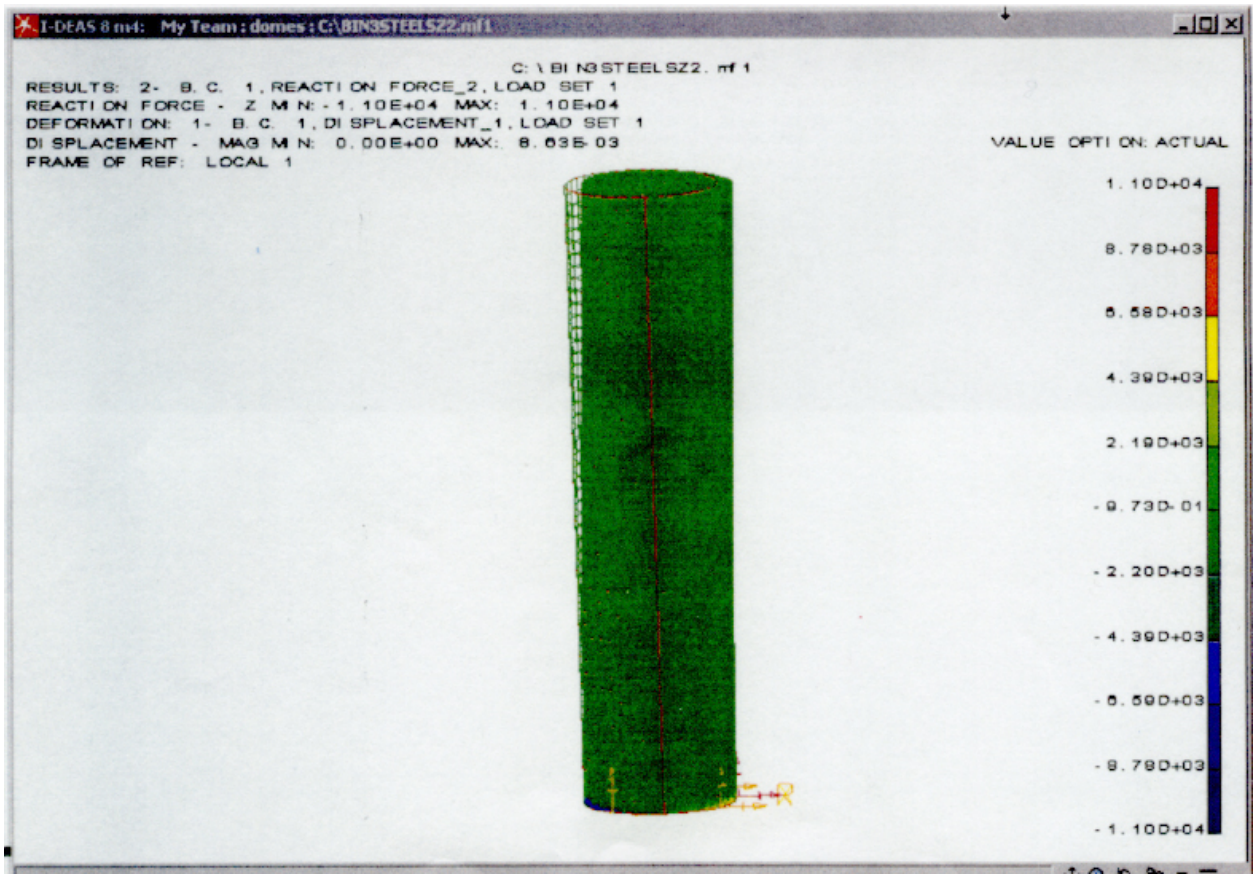

I-DEAS 8 m4: My Team : domes : C:\BIN3STEEL.mf1


I-DEAS 8 m1: My Team : domes : C:\BIN3STEEL.mf1
38(2)


I-DEAS 8 m4: My Team : domes : C:\BIN3STEEL.mf1
C: \ BI N3STEEL. mf 1
ESULTS: 3- B. C. 1, STRESS_3, LOAD SET 1
TRESS - VON MI SES MI N: 2. 25E+02 MAX: 5. 95E+05
EFORMATI ON: 1- B. C. 1, DI SPLACEMENT_1, LOAD SET 1
I SPLACEMENT - MAG MI N: 0. 00E+00 MAX: 9. 57E-04
RAME OF REF: LOCAL 1
VALUE OPTI ON: ACTUAL
SHELL SURFACE: M DDLE
5. 95D+05
5. 35D+05
4. 76D+05
4. 16D+05
3. 57D+05
2. 98D+05
2. 38D+05
1. 79D+05
1. 19D+05
5. 97D+04
2. 25D+02

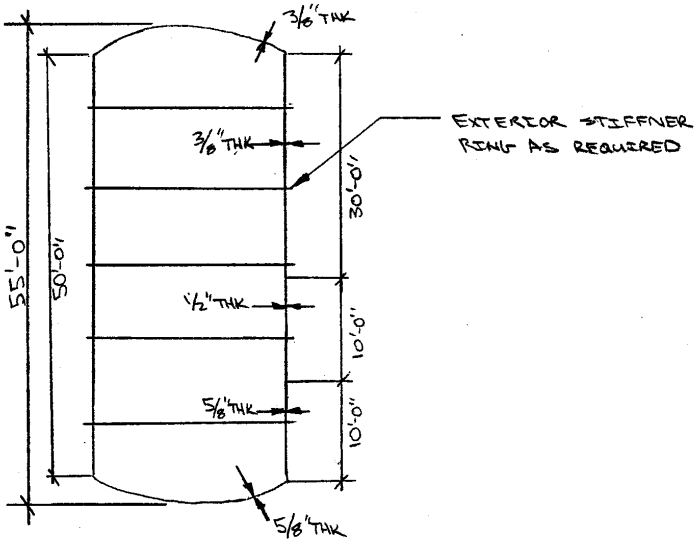
39(3)


I-DEAS 8 m4: My Team : domes : C:\BIN3STEELSZ2.mf1
C:\BIN3STEELSZ2.mf1
RESULTS: 3- B.C. 1, STRESS_3, LOAD SET 1
STRESS - VON MISES MIN: 1.26E+03 MAX: 3.06E+05
DEFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
DISPLACEMENT - MAG MIN: 0.00E+00 MAX: 8.63E-03
FRAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
SHELL SURFACE: MIDDLE
3.06D+05
2.76D+05
2.46D+05
2.15D+05
1.84D+05
1.54D+05
1.23D+05
9.27D+04
5.22D+04
3.17D+04
1.26D+03


I-DEAS 8 m4: My Team : domes : C:\BIN3STEELS22.mf1
C:\BIN3STEELSZ2.mf1
RESULTS: 2- B.C. 1, REACTION FORCE_2, LOAD SET 1
REACTION FORCE - Z MIN: -1.10E+04 MAX: 1.10E+04
DEFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
DISPLACEMENT - MAG MIN: 0.00E+00 MAX: 8.63E-03
FRAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
1.10D+04
8.78D+03
6.58D+03
4.39D+03
2.19D+03
-9.73D-01
-2.20D+03
-4.39D+03
-6.59D+03
-8.79D+03
-1.10D+04

BIN # 4

144" ø BIN (3)



PROPERTIES

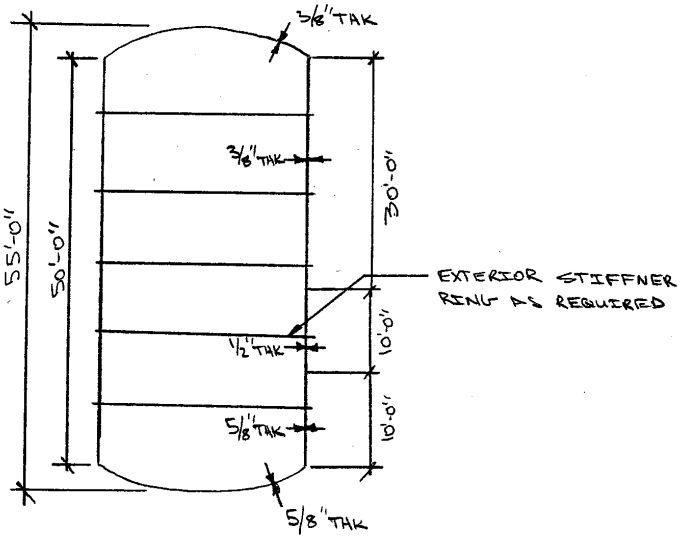
STEEL → A240-73 TYPE 304 (STAINLESS STEEL)

SIM TO BIN #3

Project Name:	Project #:	Initials:	Date:	Sheet: 42

BIN # 5

144" ø BIN (7)



PROPERTIES

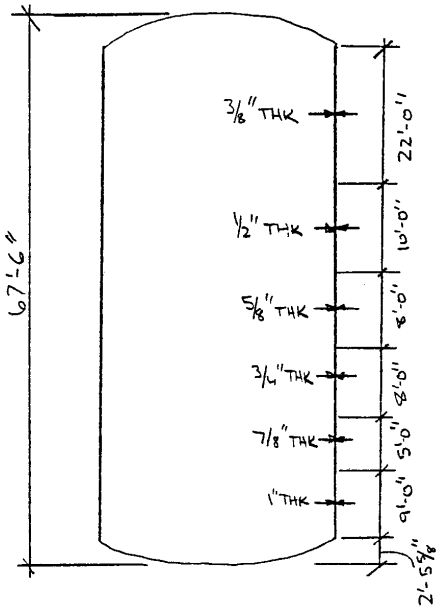
STEEL → TYPE 304L (STAINLESS STEEL)

SIM TO BIN #3

Project Name:	Project #:	Initials:	Date:	Sheet: 43

BIN #6

162" ϕ BIN (7)



PROPERTIES

STEEL → TYPE 304L (STAINLESS STEEL)

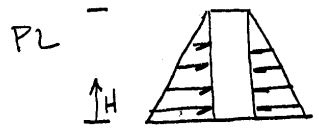
BIN #6 CONSIDERED FOR BIN #7

LOAD CASE #1 DL + PL

LOAD CASE #2 DL + PL + S2

BIN #6

- LOAD CASE #1 DL + PL



SEE JANSEN EQ

$\gamma q_c H = P$

VON MISES STRESS =

YEILD = 33 KSI

ASSUME ALLOWABLE STRESS

$= F_y = 0.603(33\text{KSI}) = 19.8\text{KSF}$

3.135 PSF OR 2187 PSI

19.8 > 2.2 KSI OK

- LOAD CASE # 2 SEE FOLLOWING PAGE FOR OVERTURNING FORCE

DL + PL + S2 W/ 1/3 STRESS INCREASE

V.M. = 1.5E3 PSF OR 1042 PSI

19.8 > 1.1 + 2.2 OK

* NOTE THIS ASSUMES V.M STRESS WORST CASE FOR (DL+PL) ALIGNS W/ V.M. STRESS WORST CASE FOR (S2)

Project Name:	Project #:	Initials:	Date:	Sheet: 45

PAN #6

- SECOND ORDER EFFECTS

VERT BUCKLING OF PAN

ALLOWABLE STRESS PER RAMPS T. & J. LIEB
TECH PAPER NO CBI 5460
1985 INT. J BULK SOLIDS
MAY 1986

$$F_{a_{all}} = 1750\, t/R \left[1 + 50{,}000 (t/R)^2\right] + \frac{0.15}{t}\sqrt{\frac{\sigma_i \times R}{E}} * E \cdot \frac{t}{R}$$

$t/R = 1/84'' = 0.0119$

$1750 (0.0119) \left[1 + 50000 (0.0119)^2\right] = 168 \text{ ksi}$

2ND TERM NOT NEEDED 168 KSI >> YIELDING

OK

Project Name:	Project #:	Initials:	Date:	Sheet: 416

BIN #6 VOL & SEISMIC FORCE CALC.

- 13'-6" dx 60'-0" VAR. THK

$VOL = (13.5)^2 \pi/4 \; 60 = 8548 \text{ ft}^3$

$MASS = \frac{120 (8548)}{1000} = 1030.6 \text{ K}$

- SEISMIC

$80\% = (1030.6 + 64.5)\, 0.8 = 876 \text{ K}$

- DETERMINATION OF ACC ON SIL TANK TO PROVIDE 80% MASS

$\frac{32.2}{64.5} = \frac{X}{876} \qquad X = 437.36 \text{ ft/s}^2$

$SEISMIC \; ACC = (0.087)(437)$

$= 38.1 \text{ ft/s}^2$

Project Name:	Project #:	Initials:	Date:	Sheet: 47

BEN #10

PG(1) FEA

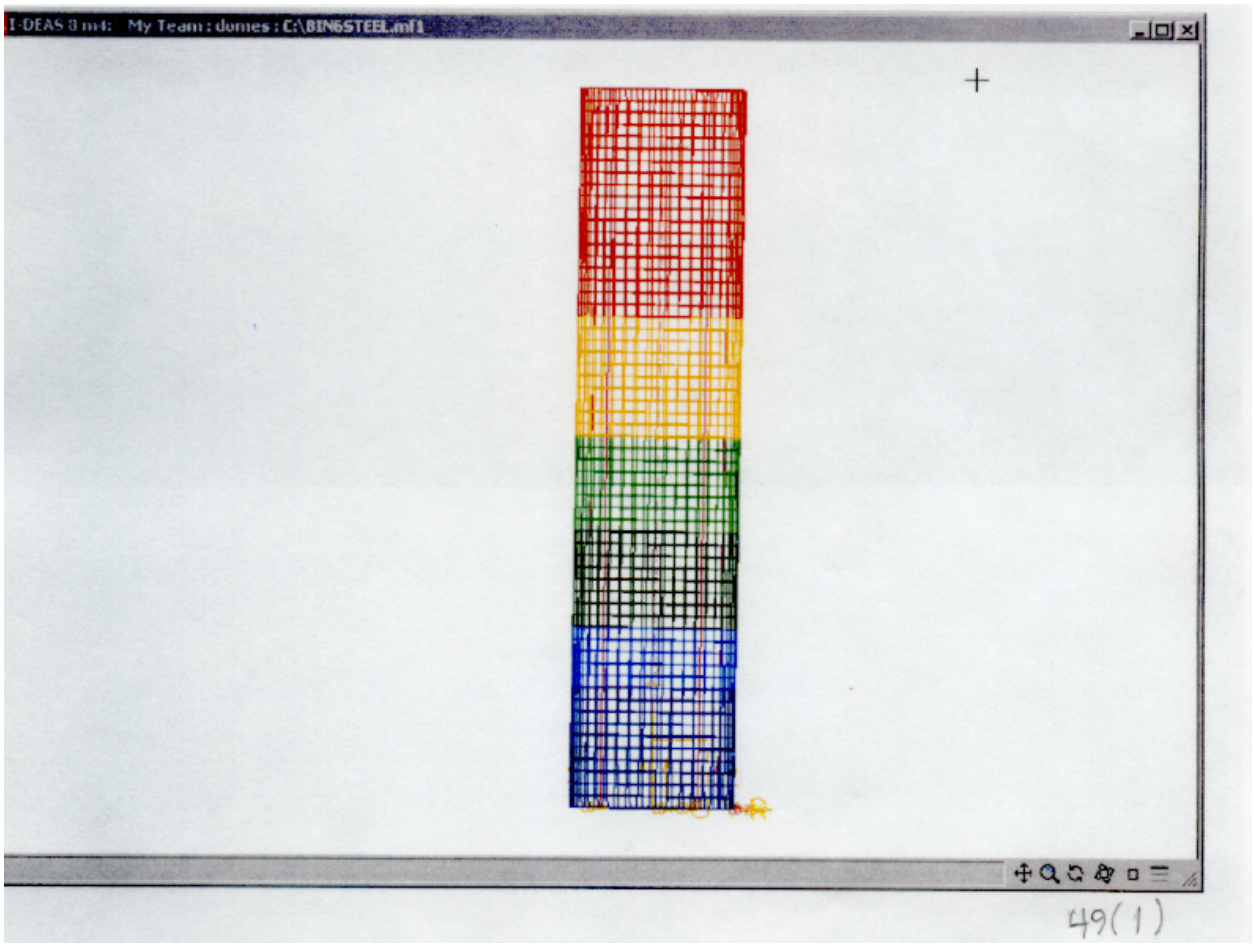
PG(2) GRANULAR LOADING & FEA (120PCF)(0.5) SEE JANSEN CALC PAGE 18

PG(3) VON MISES STRESS DL+PL (PSF)

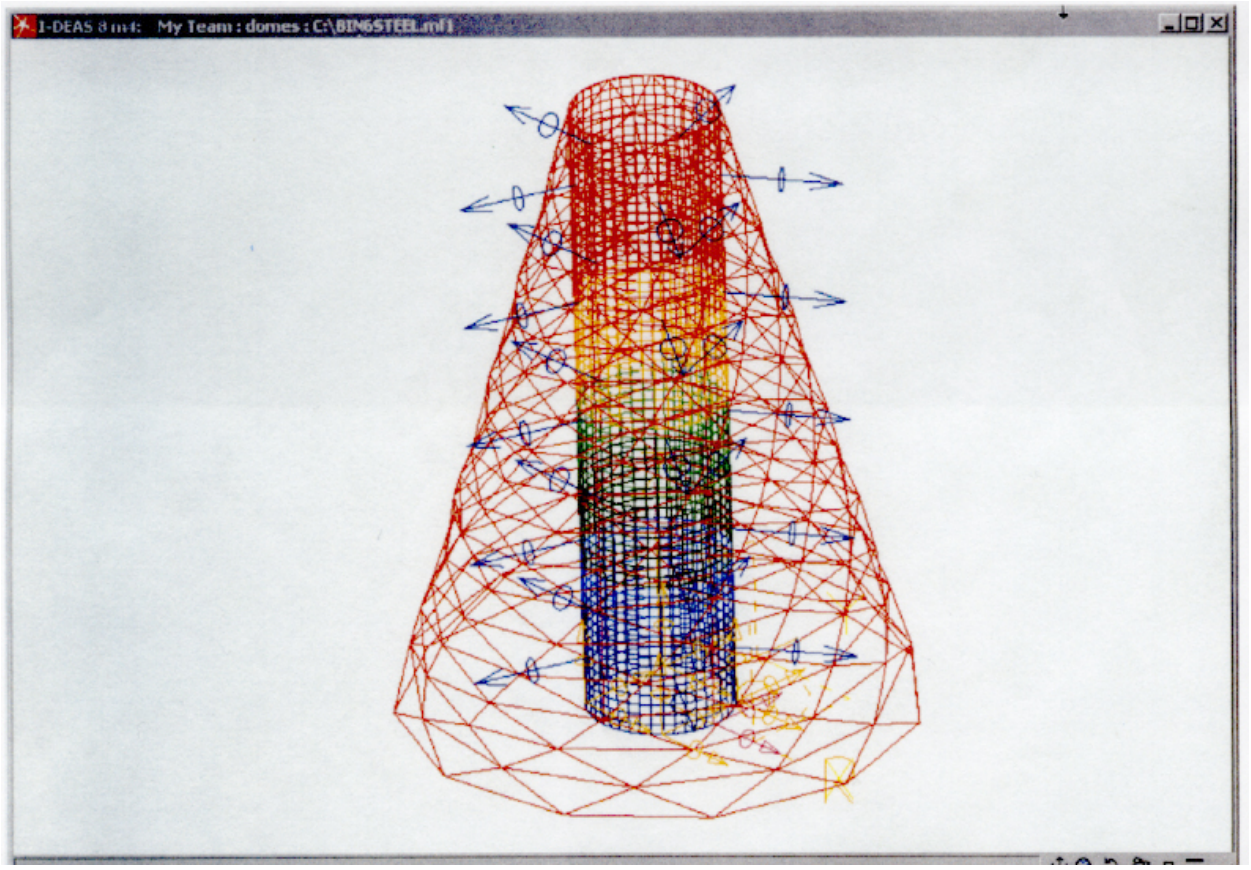
PG(4) VON MISES STRESS (SZ) (PSF)

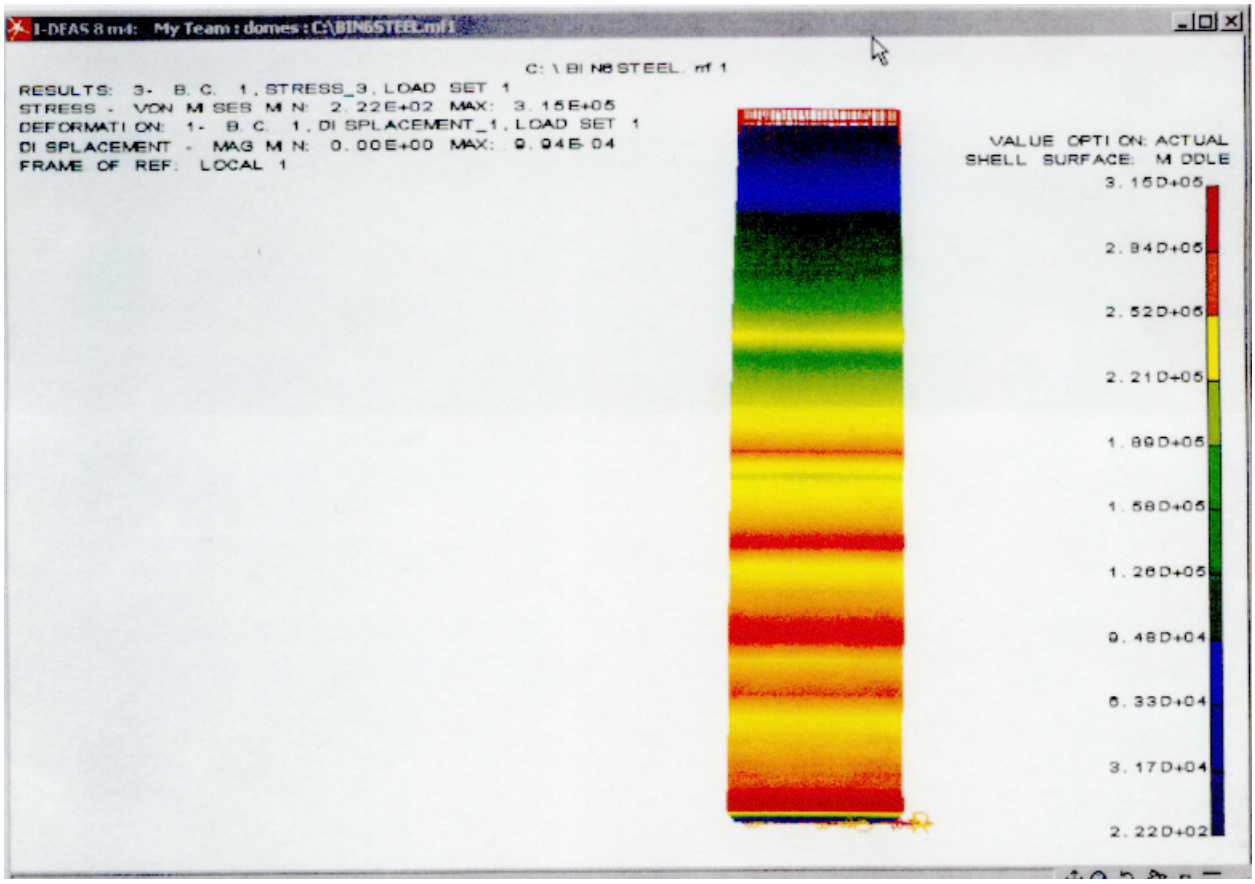
PG(5) REACTION FORCE (LB/FT)

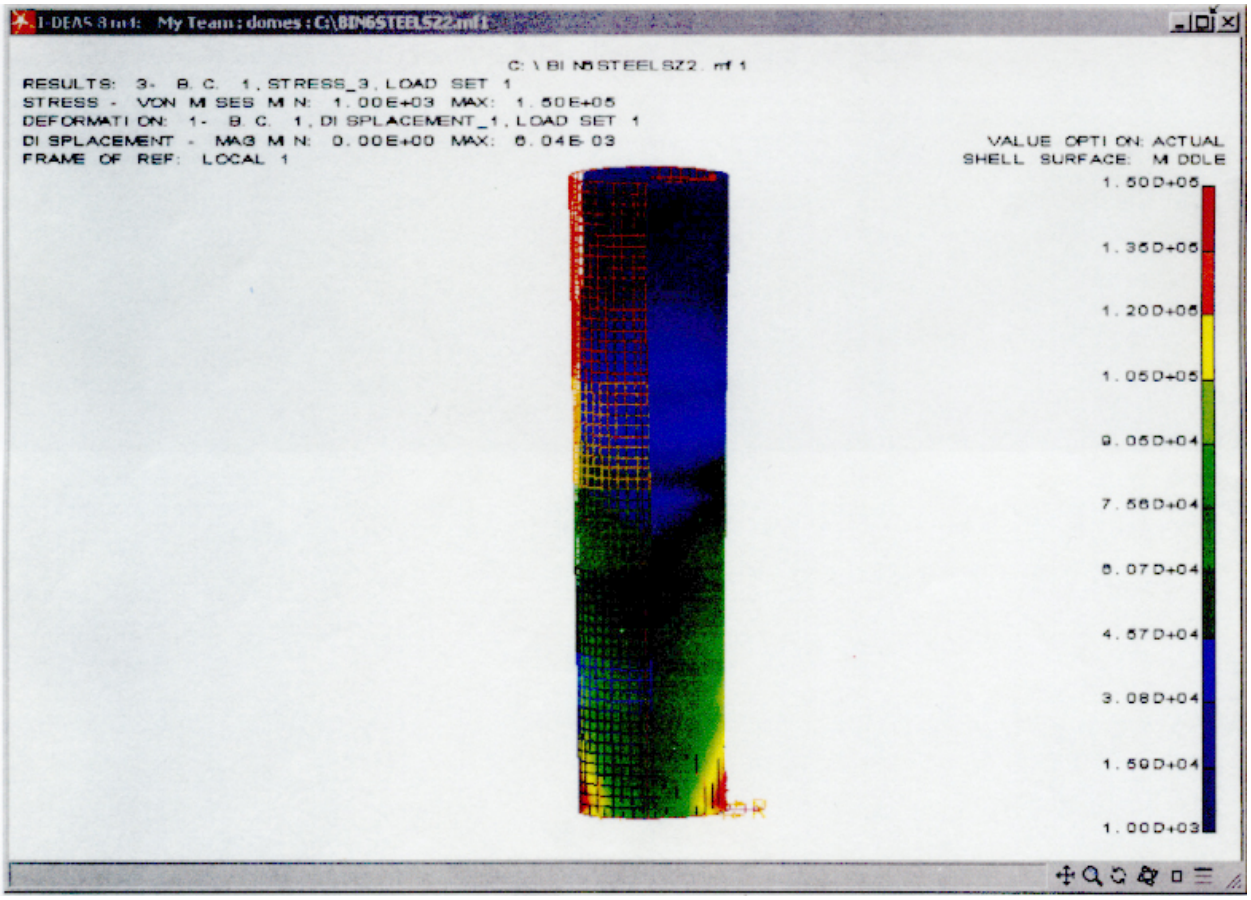
Project Name:	Project #:	Initials:	Date:	Sheet: 48

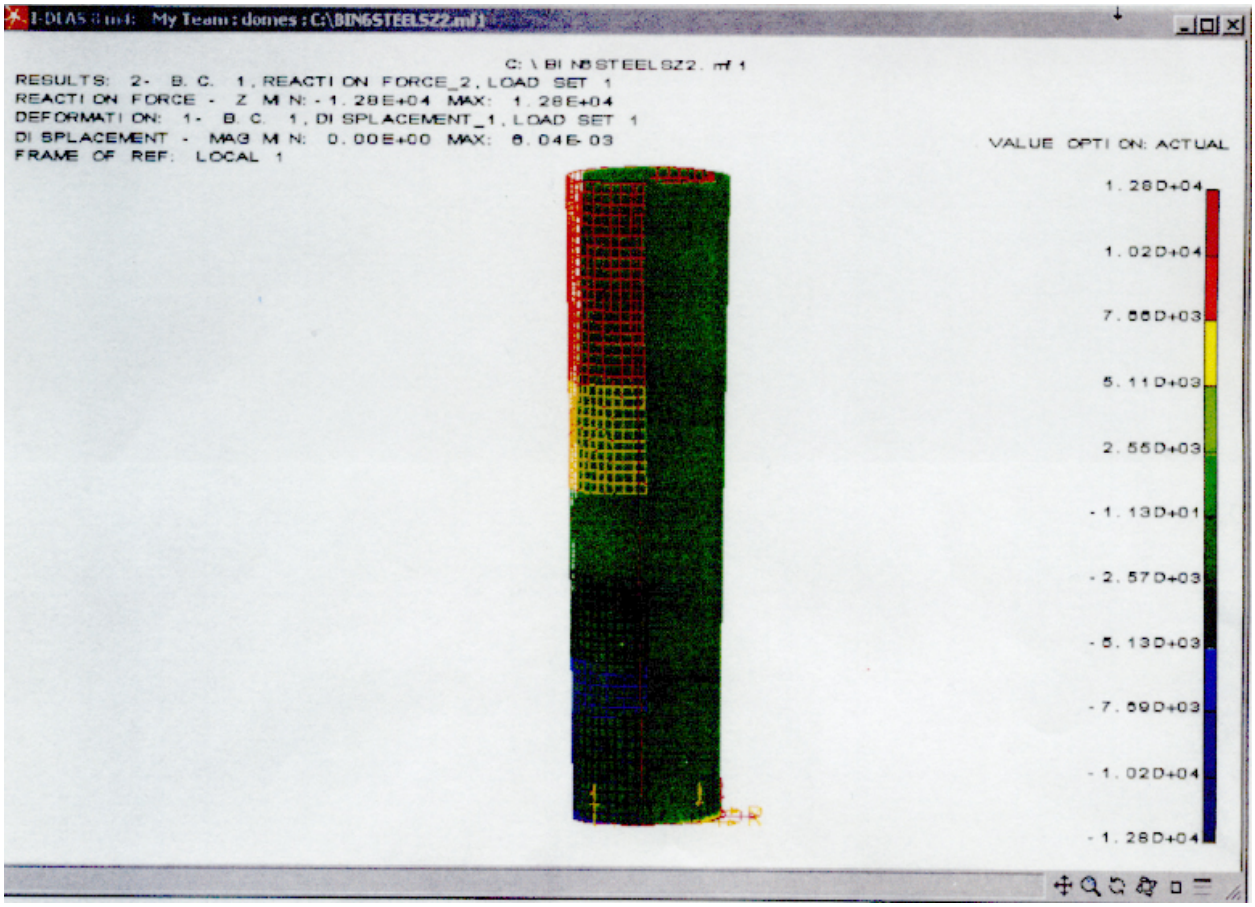


49(1)


I-DEAS 8 m4: My Team : domes : C:\BIN6STEEL.mf1

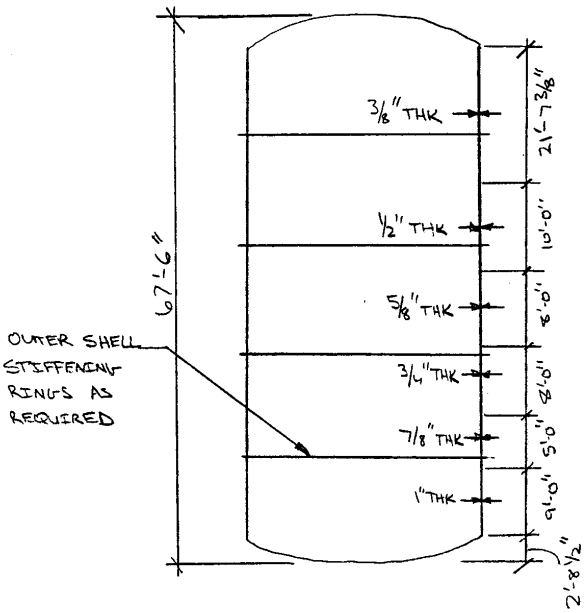

I-DEAS 8 m4: My Team : domes : C:\BIN6STEEL.mf1
C:\BIN6STEEL.mf1
RESULTS: 3- B.C. 1, STRESS_3, LOAD SET 1
STRESS - VON MISES MIN: 2.22E+02 MAX: 3.15E+05
DEFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
DISPLACEMENT - MAG MIN: 0.00E+00 MAX: 9.94E-04
FRAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
SHELL SURFACE: MIDDLE
3.15D+05
2.84D+05
2.52D+05
2.21D+05
1.89D+05
1.58D+05
1.26D+05
9.48D+04
6.33D+04
3.17D+04
2.22D+02


I-DEAS 8 nt: My Team : domes : C:\BIN6STEELSZ2.mf1
C:\BIN6STEELSZ2.mf1
RESULTS: 3- B.C. 1, STRESS_3, LOAD SET 1
STRESS - VON MISES MIN: 1.00E+03 MAX: 1.50E+05
DEFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
DISPLACEMENT - MAG MIN: 0.00E+00 MAX: 6.04E-03
FRAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
SHELL SURFACE: MIDDLE
1.50D+05
1.35D+05
1.20D+05
1.05D+05
9.05D+04
7.56D+04
6.07D+04
4.57D+04
3.08D+04
1.59D+04
1.00D+03


I-DEAS 8 nx4: My Team : domes : C:\BIN6STEELSZ2.mf1
C:\BIN6STEELSZ2.mf1
RESULTS: 2- B.C. 1, REACTION FORCE_2, LOAD SET 1
REACTION FORCE - Z MIN: -1.28E+04 MAX: 1.28E+04
DEFORMATION: 1- B.C. 1, DISPLACEMENT_1, LOAD SET 1
DISPLACEMENT - MAG MIN: 0.00E+00 MAX: 8.04E-03
FRAME OF REF: LOCAL 1
VALUE OPTION: ACTUAL
1.28D+04
1.02D+04
7.66D+03
5.11D+03
2.55D+03
-1.13D+01
-2.57D+03
-5.13D+03
-7.69D+03
-1.02D+04
-1.28D+04

BIN #7

161 1/4" ø BIN (7)



PROPERTIES

STEEL → TYPE 304L (STAINLESS STEEL)

SIM. TO BIN 6.

Project Name:	Project #:	Initials:	Date:	Sheet: 54

CHECK A.B. BIN 1 (BIN #1 HALF THE SIZE OF BIN #2, USE HALF THE FORCE)

SHEAR FORCE ASSUME 1/2 BOLTS TAKE SHEAR

TENSION FORCE " " TENSION

BASE SHEAR $419\,k\,(0.087)/2 = 18.22K$

TENSION FROM REACTION FEA = 3.1 k/ft
(USE HALF THE FORCE #2 FOR #1)

BOLT SHEAR $36.5/8 = 4.56\,k/\text{BOLT}$

BOLT TENS. $12\pi/16$ 2.35 k/BOLT

$2.35\,(3.1\,k/ft) = 7.3\,k$

CONCRETE DOES NOT CONTROL

BY INSPECTION

BOLTS IN TENSION N.G.

7.3.7 16.6 (.7) OK

AB BINS 3,4,5

SEE ATTACHED

$B.S = 569\,(0.087) = 49.5\,K$

$T = 11.0\,K/ft$

B.U. $49.5k/9 = 5.5k/\text{BOLT}$ ok

T $12.33\pi/18 = 23.67$

$\times\ 11.0$

667 33.8

23.67/.7

ok

Project Name:	Project #:	Initials:	Date:	Sheet: 55

ANCHOR BOLTS con.

Pan 6.7

B.S = 876 (0.087) = 76.2K

T = 12.8 k/ft

B.V $76.2/18$ = 4.24 K/BOLT

T = $13.5 \text{ ft}/36$ = 15.1

x 12.8

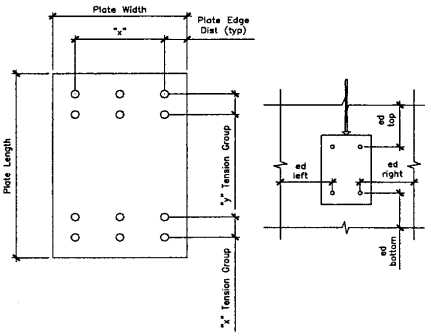
381k > 15.1k/.07 = 21.6k

ok

Project Name:	Project #:	Initials:	Date:	Sheet: 56

CONCRETE EMBED PLATE DESIGN

DESCRIPTION: **BIN 1**



MATERIALS:

concrete f'_c (psi):	2500
anchor tensile strength f_{ut} (ksi):	60
ϕ:	0.65
SPECIAL INSPECTION? (Y/N):	N
located in tension zone ? (Y/N):	Y
additional load multiplier, alm:	3.0
concrete type (1-3):	1
normal wt (1), lightwt. (2), sand lwt (3)	
λ:	1.00

GEOMETRY:

anchor diam. (in):	0.625	x (in):	4	concrete thickness (in):	24
anchor length,le (in):	12	y tens. group (in):	0	Ed left (in):	12
no. of anchors tens. group, a_t :	1	y compr. group (in):	0	Ed right (in):	12
# of rows in tens. group:	1	embed plate width (in):	12	Ed bottom (in):	12
no. of anchors compr. group, a_c:	0	embed plate length (in):	12	Ed top (in):	12
# of rows in comp. group:	0	embed plate thickness (in):	1		
A_b (in^2):	0.31	plate edge distance (in):	4		

LOADS: Applied factored loads ...

Vu (kips):	0.0	Vu tension group (kips):	0.0	Pu at tension group (kips):	0.0
Mu (k-ft):	0.0	Vu compression group (kips):	0.0	Pu at compression group (kips):	0.0
direct pullout Pu (kips):	0.0	a (in):	0.65		
e (in. from conc. face):	0.00				

TENSION STRENGTH:

	Thick slab projected failure surface...	Thin slab projected failure surface...	Steel control ...
STEEL CONTROLS	length (in): 24.0	length (in): 24.0	Pss (kips): 16.6
	width (in): 28.0	width (in): 28.0	
	A_p (in^2): 672.0	A_p (in^2): 672.0	
	Pc (kips): 134.4	Pc (kips): 134.4	
		THIN SLAB GOVERNS	

SHEAR STRENGTH:

	Vc tension group (kips) ...		Vc compression group (kips) ...		Steel control ...
CONCRETE CONTROLS	weakest anchor x no. of anchors	12.3 <<--- GOVERNS	0.0	<<--- GOVERNS	Vss (kips): 13.8
	weakest row based on edge dist. x number of rows	12.3	0.0		Vc total (kips): 12.3
	strongest row based on edge distance	12.3	0.0		

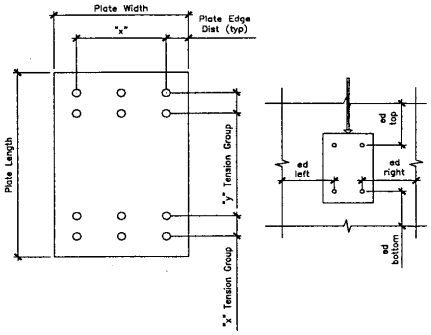
(Used only when edge distance is less than 10 diameters)

COMBINED STRESSES:

	Tension group ...	Compression group ...
1 /f(Pu /Pc):	0.00 OK	---
1 /f(Vu /Vc):	0.00 OK	##### #DIV/0!
1 /f[(Pu /Pc)$^{5/3}$ + (Vu /Vc)$^{5/3}$]:	0.00 OK	##### #DIV/0!
(Pu /Pss)^2 + (Vu /Vss)^2:	0.00 OK	0.00 OK

CONCRETE EMBED PLATE DESIGN

DESCRIPTION: BIN ~~12~~ 6,7.



MATERIALS:
- concrete f'c (psi): 2500
- anchor tensile strength f_{ut} (ksi): 60
- ϕ: 0.65
- SPECIAL INSPECTION? (Y/N): N
- located in tension zone ? (Y/N): Y
- additional load multiplier, alm: 3.0
- concrete type (1-3): 1
  normal wt (1), lightwt. (2), sand ltwt (3)
- λ: 1.00

GEOMETRY:
- anchor diam. (in): 3
- anchor length le (in): 47
- no. of anchors tens. group, a_t : 1
- # of rows in tens. group: 1
- no. of anchors compr. group, a_c: 0
- # of rows in comp. group: 0
- Ab (in^2): 7.07
- x (in): 4
- y tens. group (in): 0
- y compr. group (in): 0
- embed plate width (in): 12
- embed plate length (in): 12
- embed plate thickness (in): 1
- plate edge distance (in): 4
- concrete thickness (in): 24
- Ed left (in): 12
- Ed right (in): 12
- Ed bottom (in): 12
- Ed top (in): 12

LOADS: Applied factored loads ...
- Vu (kips): 0.0
- Mu (k-ft): 0.0
- direct pullout Pu (kips): 0.0
- e (in. from conc. face): 0.00
- Vu tension group (kips): 0.0
- Vu compression group (kips): 0.0
- a (in): 5.27
- Pu at tension group (kips): 0.0
- Pu at compression group (kips): 0.0

TENSION STRENGTH: CONCRETE CONTROLS

Thick slab projected failure surface...
- length (in): 24.0
- width (in): 28.0
- Ap (in^2): 672.0
- Pc (kips): 134.4

Thin slab projected failure surface...
- length (in): 24.0
- width (in): 28.0
- Ap (in^2): 672.0
- Pc (kips): 134.4

THIN SLAB GOVERNS

Steel control ...
- Pss (kips): 381.7

SHEAR STRENGTH: #DIV/0!

	Vc tension group (kips) ...		Vc compression group (kips) ...		Steel control ...
weakest anchor x no. of anchors	45.2	<<-- GOVERNS	0.0	#DIV/0!	Vss (kips): 318.1
weakest row based on edge dist. x number of rows	45.2		0.0	#DIV/0!	Vc total (kips): #DIV/0!
strongest row based on edge distance	45.2		#DIV/0!		

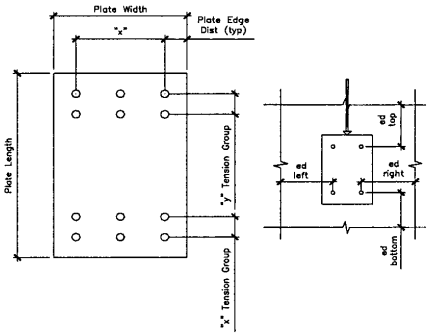
(Used only when edge distance is less than 10 diameters)

COMBINED STRESSES:

	Tension group ...		Compression group ...	
1 /f(Pu /Pc):	0.00	OK	---	
1 /f(Vu /Vc):	0.00	OK	#####	#DIV/0!
1 /f[(Pu /Pc)$^{5/3}$ + (Vu /Vc)$^{5/3}$]:	0.00	OK	#####	#DIV/0!
(Pu /Pss)^2 + (Vu /Vss)^2:	0.00	OK	0.00	OK

CONCRETE EMBED PLATE DESIGN

DESCRIPTION: BIN ~~1~~ 2345



MATERIALS:

concrete f'c (psi):	2500
anchor tensile strength f_{ut} (ksi):	60
ϕ:	0.65
SPECIAL INSPECTION? (Y/N):	N
located in tension zone ? (Y/N):	Y
additional load multiplier, alm:	3.0
concrete type (1-3):	1
normal wt (1), lightwt. (2), sand ltwt (3)	
λ:	1.00

GEOMETRY:

anchor diam. (in):	1.25	x (in):	4	concrete thickness (in):	24
anchor length le (in):	20	y tens. group (in):	0	Ed left (in):	12
no. of anchors tens. group, a_t :	1	y compr. group (in):	0	Ed right (in):	12
# of rows in tens. group:	1	embed plate width (in):	12	Ed bottom (in):	12
no. of anchors compr. group, a_c:	0	embed plate length (in):	12	Ed top (in):	12
# of rows in comp. group:	0	embed plate thickness (in):	1		
Ab (in^2):	1.23	plate edge distance (in):	4		

LOADS: Applied factored loads ...

Vu (kips):	0.0	Vu tension group (kips):	0.0	Pu at tension group (kips):	0.0
Mu (k-ft):	0.0	Vu compression group (kips):	0.0	Pu at compression group (kips):	0.0
direct pullout Pu (kips):	0.0	a (in):	2.60		
e (in. from conc. face):	0.00				

TENSION STRENGTH:

STEEL CONTROLS	Thick slab projected failure surface...	Thin slab projected failure surface...	Steel control ...
	length (in): 24.0	length (in): 24.0	Pss (kips): 66.3
	width (in): 28.0	width (in): 28.0	
	Ap (in^2): 672.0	Ap (in^2): 672.0	
	Pc (kips): 134.4	Pc (kips): 134.4	
		THIN SLAB GOVERNS	

SHEAR STRENGTH:

#DIV/0!	Vc tension group (kips) ...		Vc compression group (kips) ...		Steel control ...
	weakest anchor x no. of anchors	45.2 <<-- GOVERNS	0.0	#DIV/0!	Vss (kips): 55.2
	weakest row based on edge dist. x number of rows	45.2	0.0	#DIV/0!	Vc total (kips): #DIV/0!
	strongest row based on edge distance	45.2	#DIV/0!		

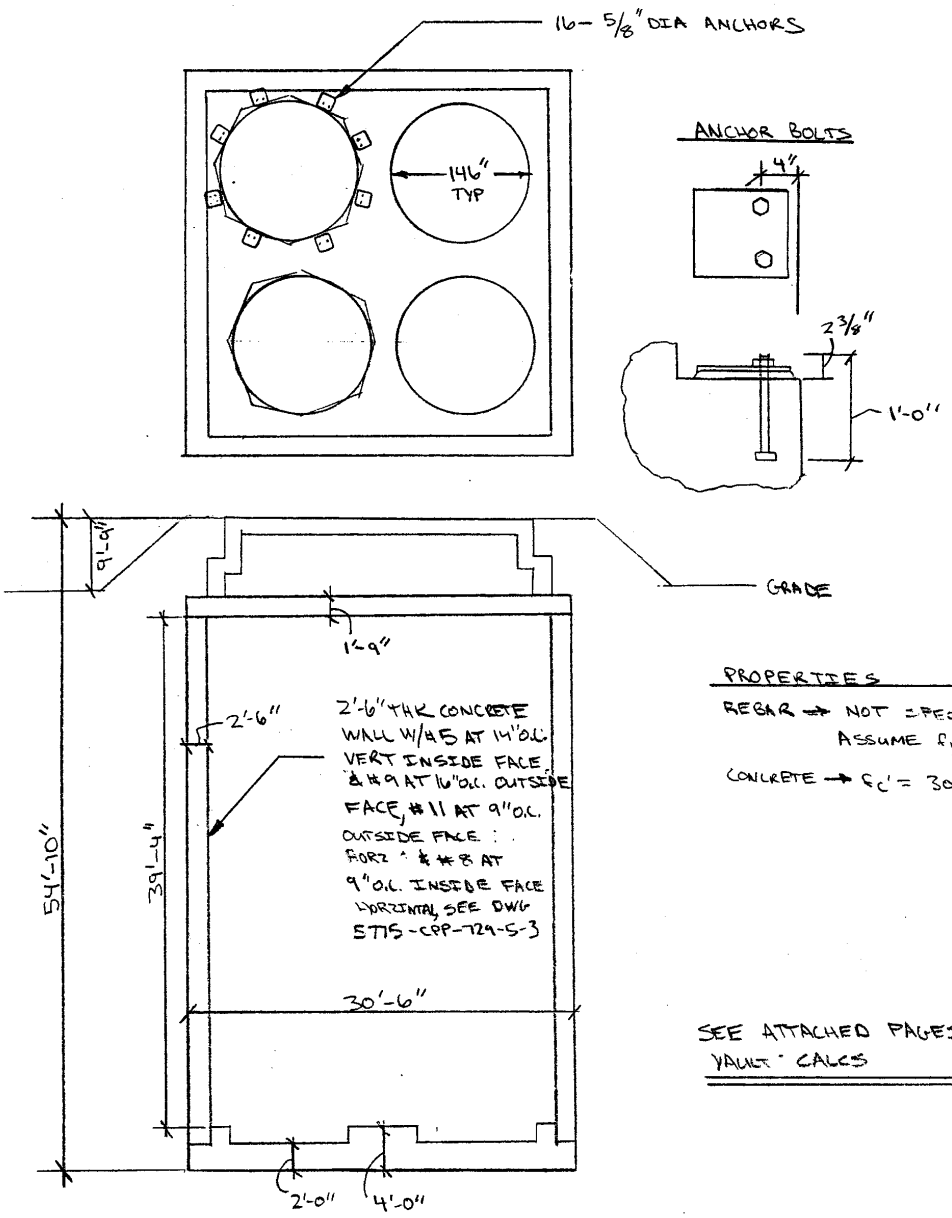
(Used only when edge distance is less than 10 diameters)

COMBINED STRESSES:

	Tension group ...	Compression group ...
1 /f(Pu /Pc):	0.00 OK	---
1 /f(Vu /Vc):	0.00 OK	##### #DIV/0!
1 /f[(Pu /Pc)$^{5/3}$ + (Vu /Vc)$^{5/3}$]:	0.00 OK	##### #DIV/0!
(Pu /Pss)^2 + (Vu /Vss)^2:	0.00 OK	0.00 OK

edited 6/3/02

BIN #1 (VAULT #1)



PROPERTIES

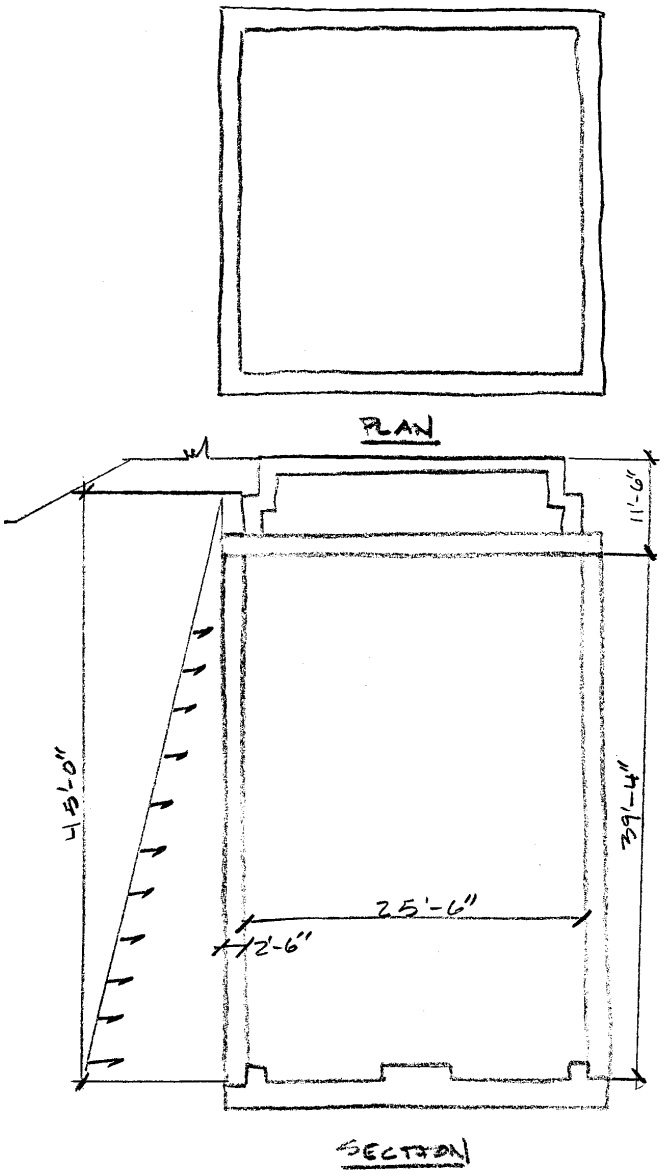
REBAR → NOT SPECIFIED
ASSUME f_y = 60ksi

CONCRETE → f_c' = 3000 psi

SEE ATTACHED PAGES FOR CONCRETE VAULT CALCS

Project Name:	Project #:	Initials:	Date:	Sheet: 60

LOADING VAULT #1

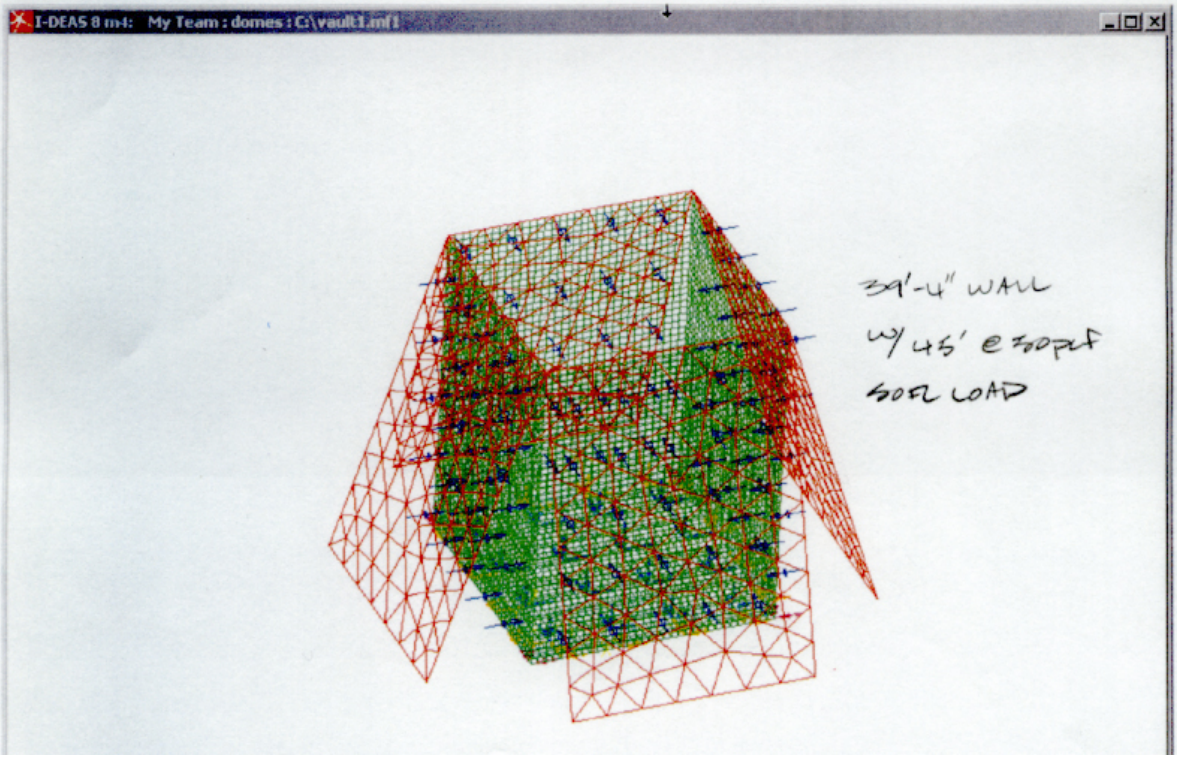


ASSUME 9'-9" SLOPED BERM IMPOSES 5'0" SURCHARE W/ SAME EFFECT AS ~~=~~ SOIL. USE 50 PCF FROM GOLDER & ASSOC. SOIL REPORT.

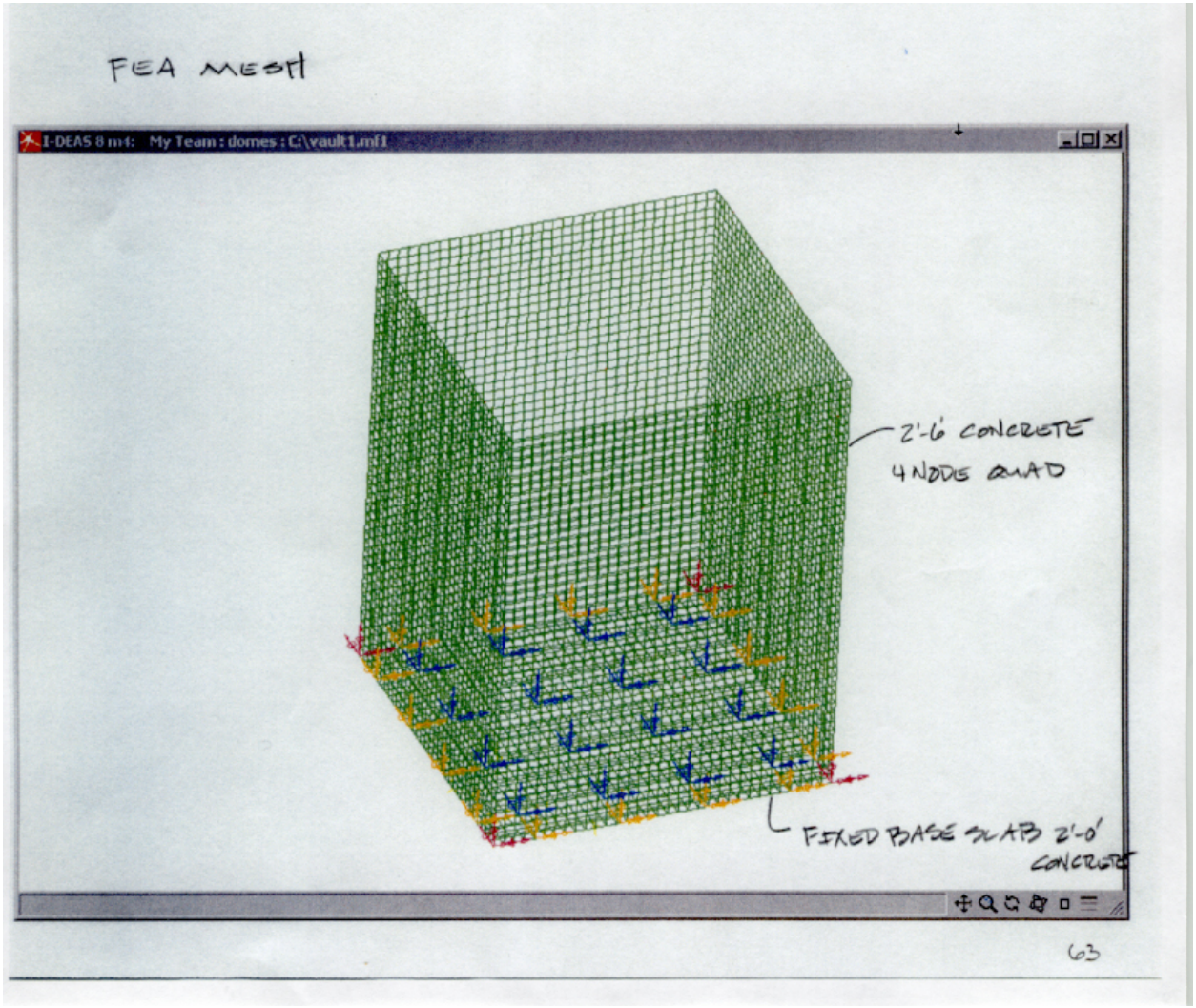
Project Name:	Project #:	Initials:	Date:	Sheet:
				61

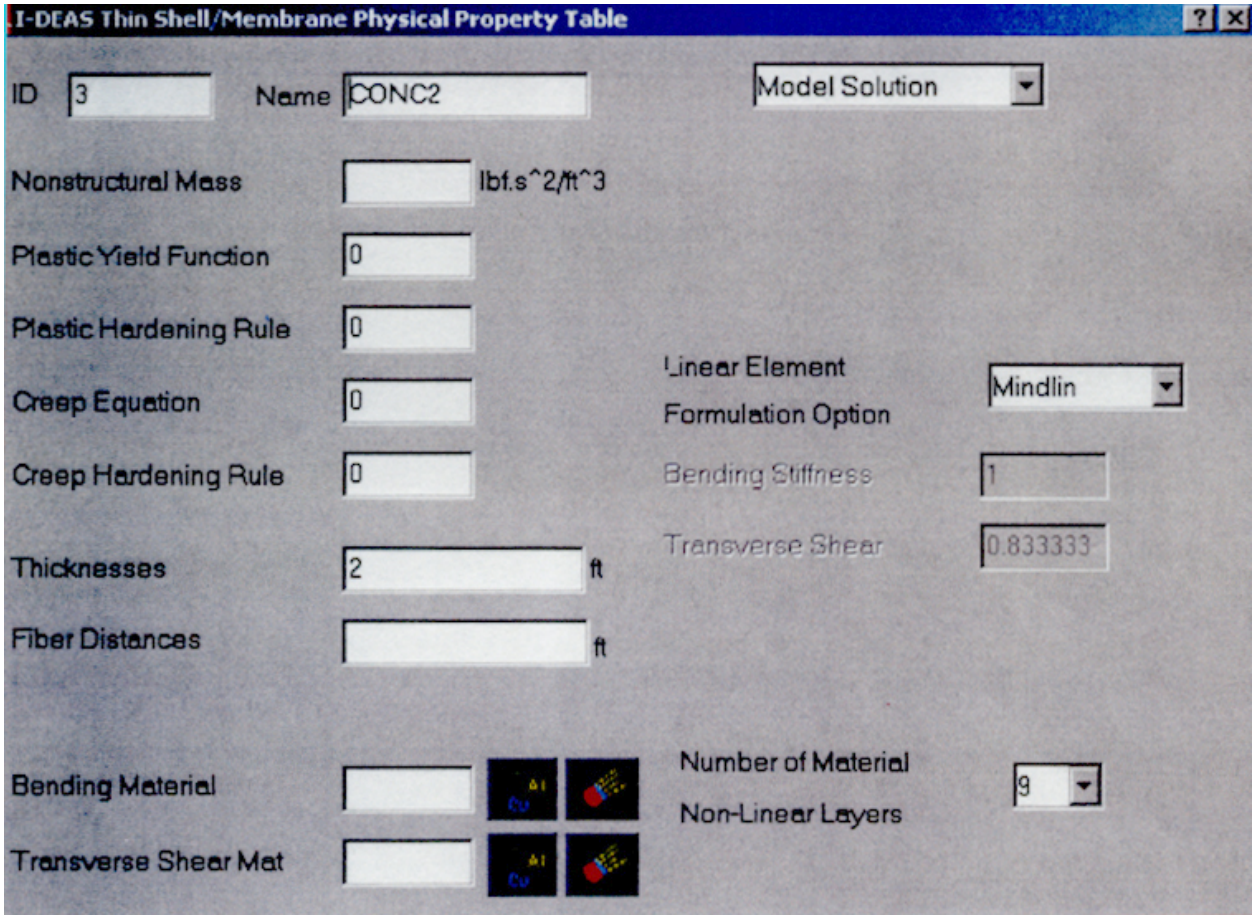
VAULT #1

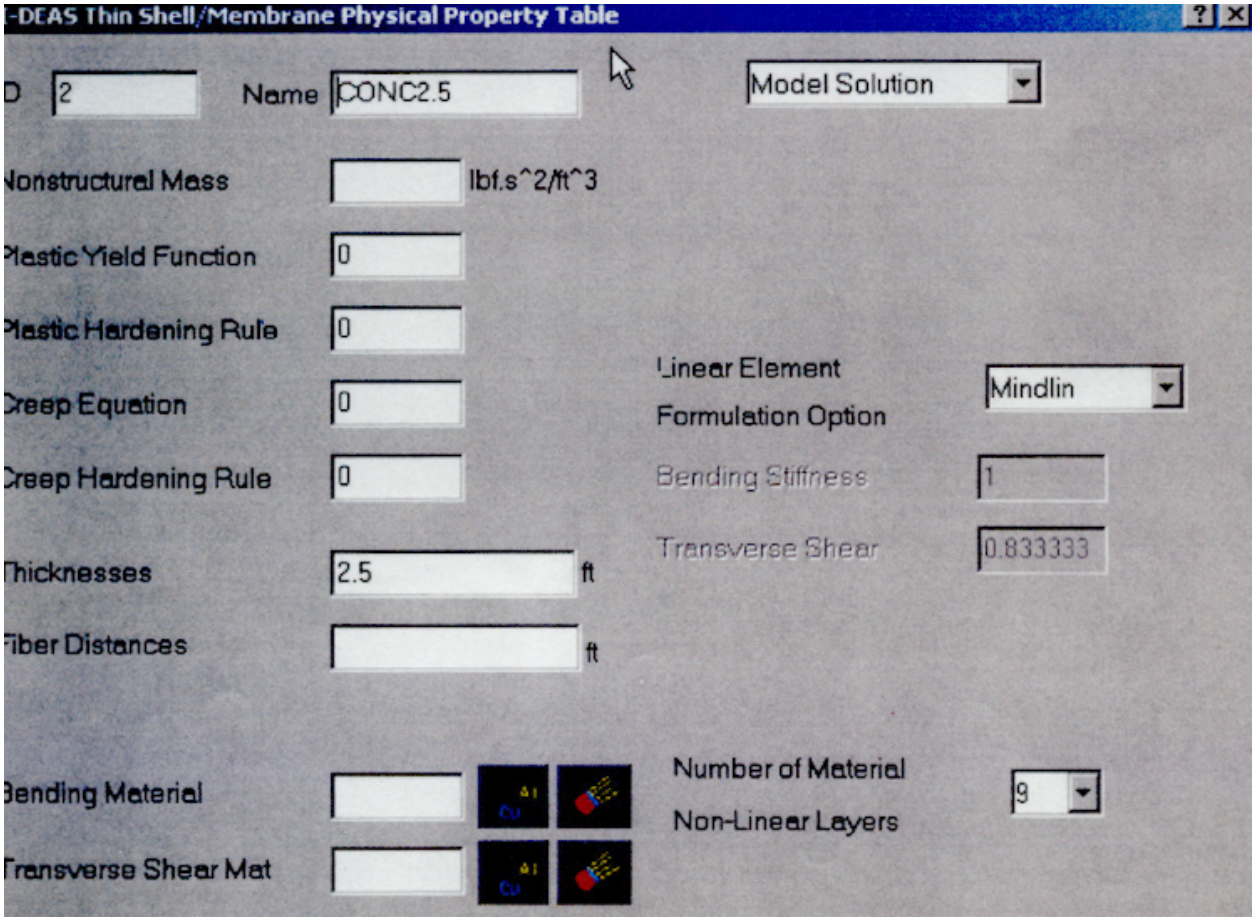
FEA LOADING

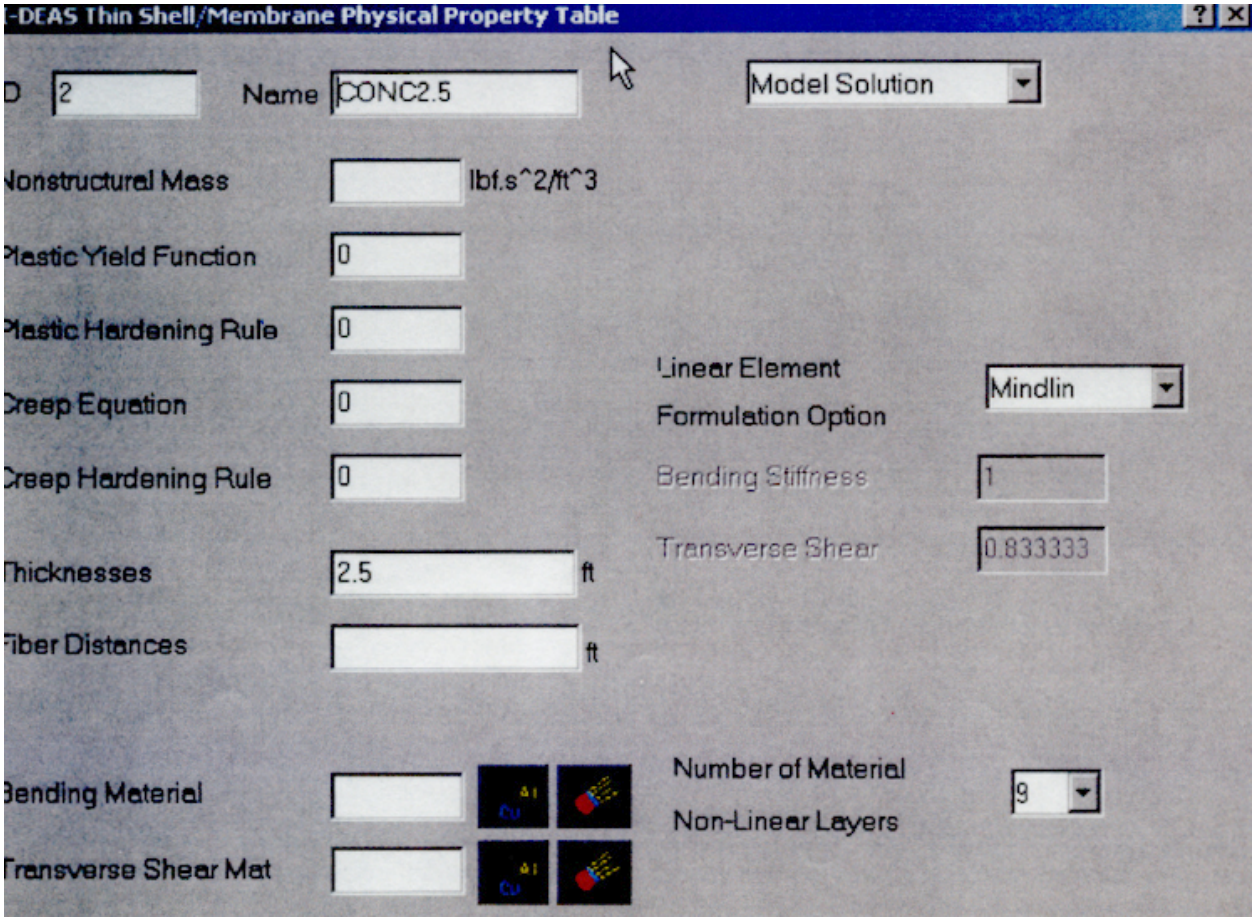


Vault #1


FEA MESH
I-DEAS 8 m4: My Team : domes : C:\vault1.mf1
2'-6 CONCRETE
4 NODE QUAD
FIXED BASE SLAB 2'-0'
CONCRETE
63


I-DEAS Thin Shell/Membrane Physical Property Table
ID
3
Name
CONC2
Model Solution
Nonstructural Mass
lbf.s^2/ft^3
Plastic Yield Function
0
Plastic Hardening Rule
0
Creep Equation
0
Creep Hardening Rule
0
Linear Element
Formulation Option
Mindlin
Bending Stiffness
1
Transverse Shear
0.833333
Thicknesses
2
ft
Fiber Distances
ft
Bending Material
Transverse Shear Mat
Number of Material
Non-Linear Layers
9


I-DEAS Thin Shell/Membrane Physical Property Table
ID 2
Name CONC2.5
Model Solution
Nonstructural Mass
lbf.s^2/ft^3
Plastic Yield Function 0
Plastic Hardening Rule 0
Creep Equation 0
Creep Hardening Rule 0
Linear Element Formulation Option
Mindlin
Bending Stiffness 1
Transverse Shear 0.833333
Thicknesses 2.5 ft
Fiber Distances ft
Bending Material
Transverse Shear Mat
Number of Material Non-Linear Layers 9


I-DEAS Thin Shell/Membrane Physical Property Table
ID 2
Name CONC2.5
Model Solution
Nonstructural Mass
lbf.s^2/ft^3
Plastic Yield Function 0
Plastic Hardening Rule 0
Creep Equation 0
Creep Hardening Rule 0
Linear Element Formulation Option
Mindlin
Bending Stiffness 1
Transverse Shear 0.833333
Thicknesses 2.5 ft
Fiber Distances ft
Bending Material
Transverse Shear Mat
Number of Material Non-Linear Layers 9

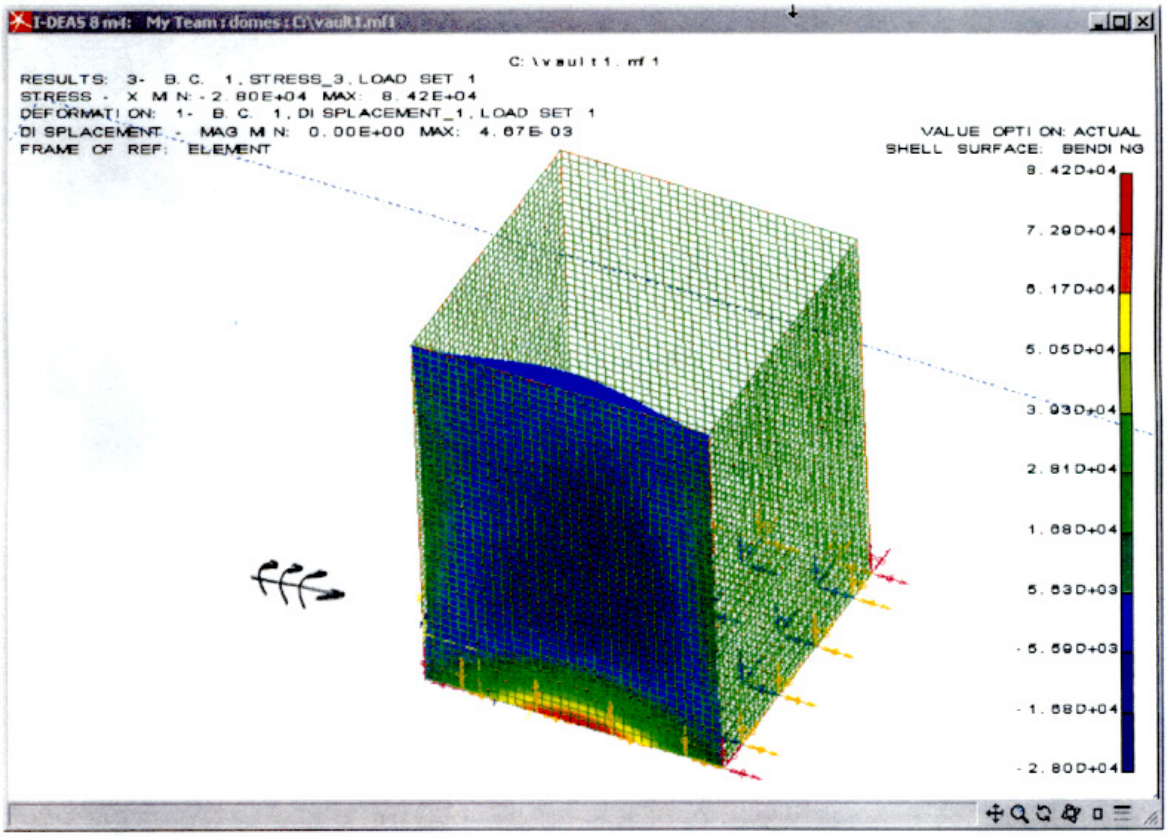
TOP TO BOTTOM
FLEX IN WALL

$M_u = 1.7\ (1.04)\ \frac{9.42E4 + 2.81E4}{2} = 99{,}273\ \#\text{-}'/_{FT}$ ← AVERAGE, LOAD DISTRIBUTED HORZ.

@ BASE WALL

M_u

@ MID WALL $= (1.7)(1.04)\ \frac{2.9E4 + 5.63E3}{2} = 29{,}730\ \#\text{-}'/_{FT}$ ← AVERAGE, LOAD DISTRIBUTED HORZ



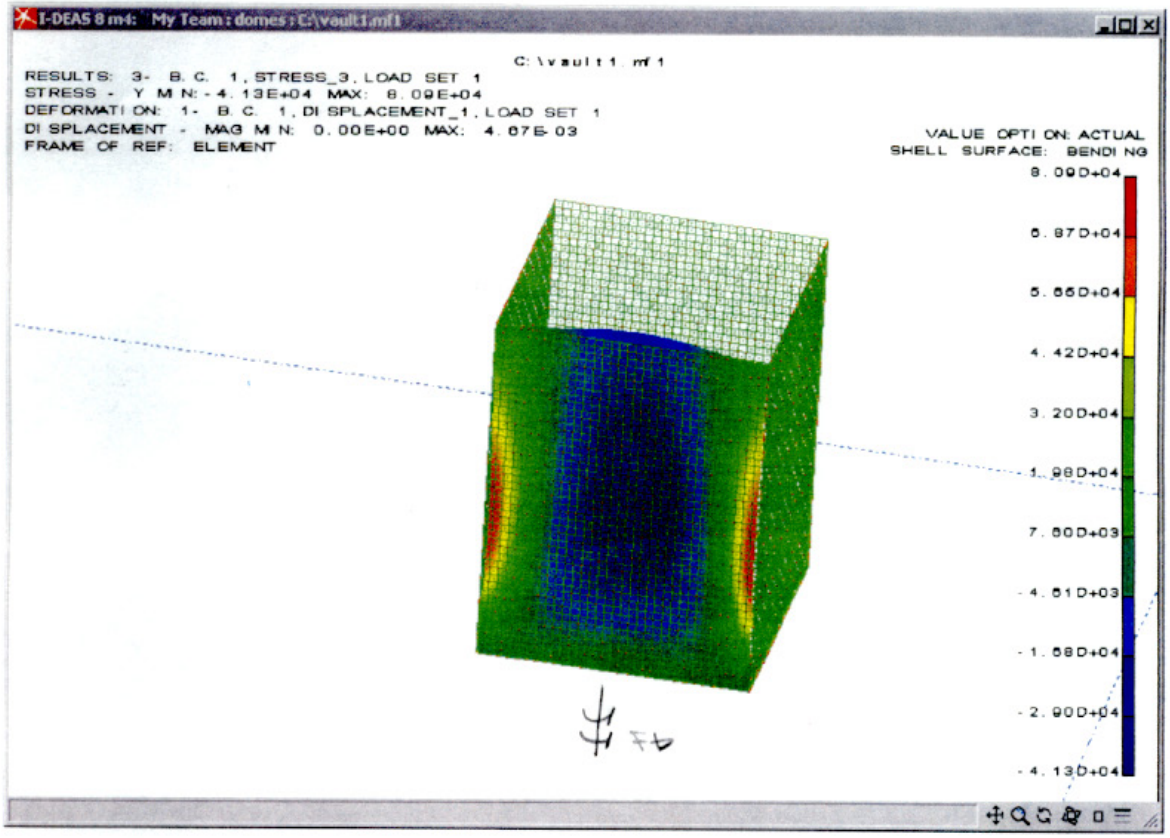
SIDE TO SIDE

FLEXURE IN WALL

$M_u = (1.7)(5)F_b = \frac{4(2.6)^2}{6}(8.09E4)(1.7) = 143,260\ \#'/_{Ft}$

@ WALL

$M_u @ CENTER = 4.13E4\ \frac{(26)^2}{6}(1.7) = 73,133\ \#'/_{Ft}$



SHEAR

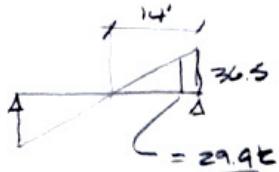
MAX SHEAR 5120 psf OR OVER 2.5 Title 4 1.7 FACTOR

= 21,760 lbs

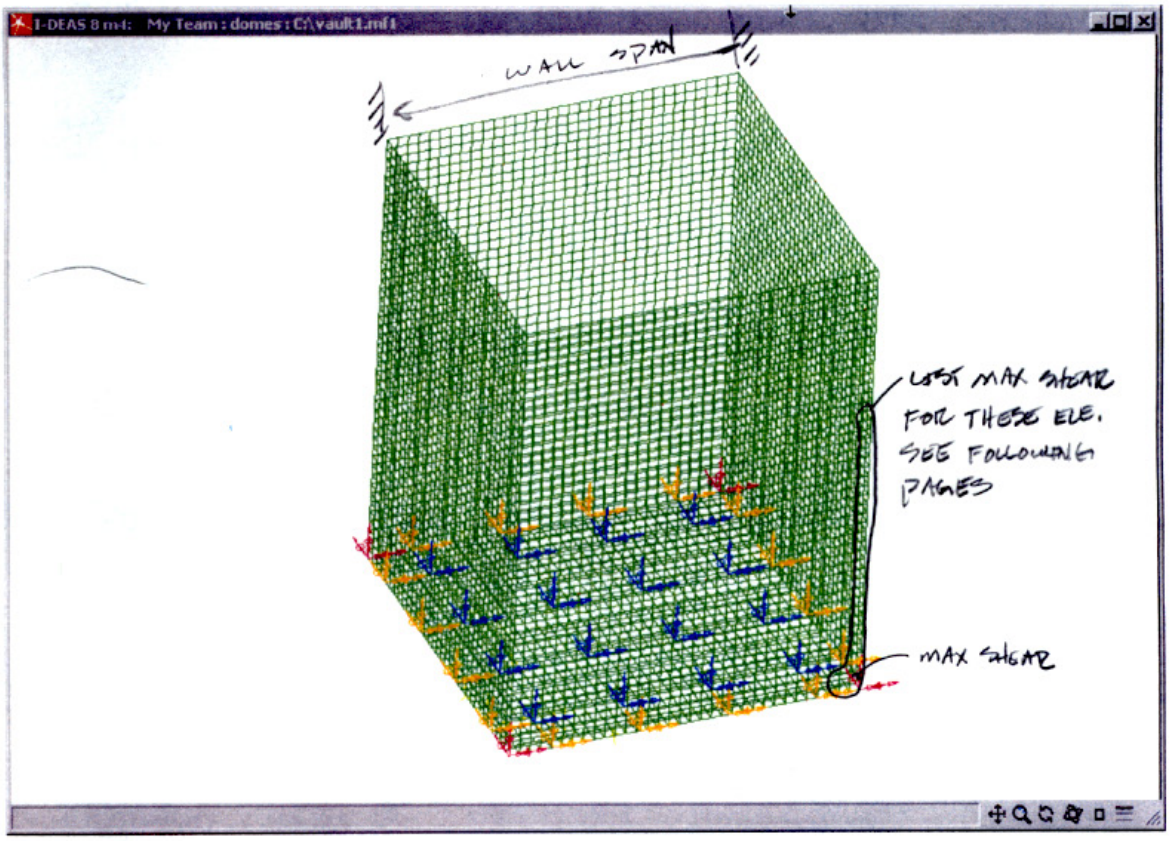
CONSIDER AXIAL FORCE & SHEARED

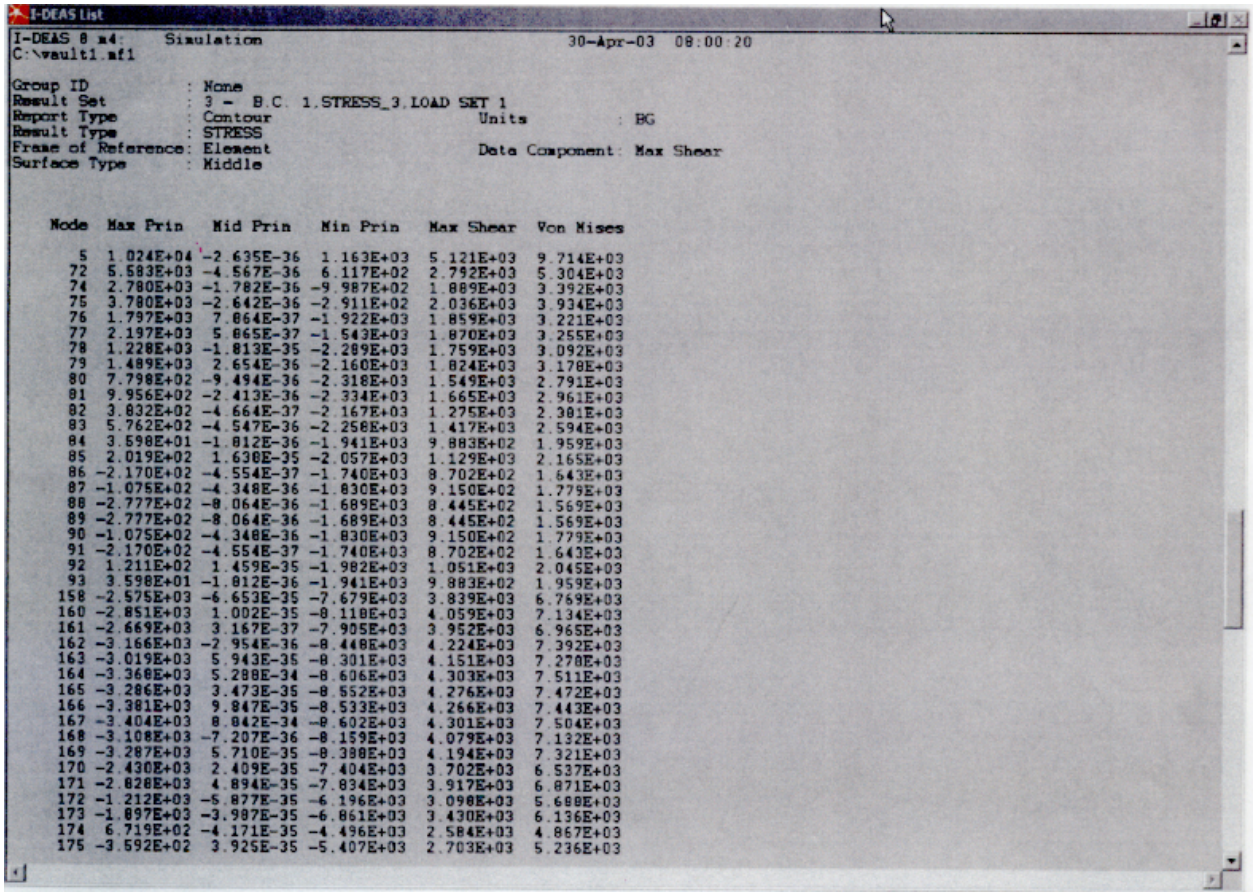
AXIAL FORCE

36.5k SHEARED

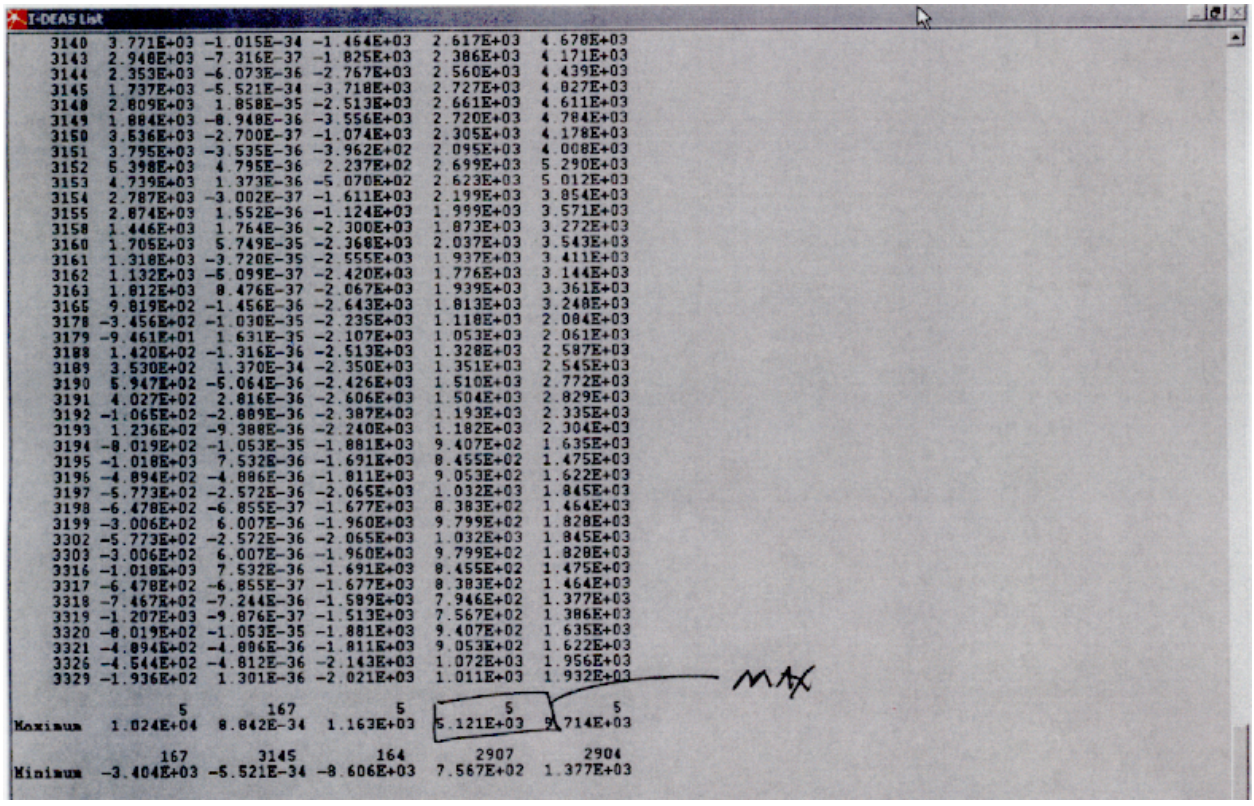


= 29.9k CLOSE TO 21.7k ok





Node	Max Prin	Mid Prin	Min Prin	Max Shear	Von Mises
5	1.024E+04	-2.635E-36	1.163E+03	5.121E+03	9.714E+03
72	5.583E+03	-4.567E-36	6.117E+02	2.792E+03	5.304E+03
74	2.780E+03	-1.782E-36	-9.987E+02	1.889E+03	3.392E+03
75	3.780E+03	-2.642E-36	-2.911E+02	2.036E+03	3.934E+03
76	1.797E+03	7.864E-37	-1.922E+03	1.859E+03	3.221E+03
77	2.197E+03	5.865E-37	-1.543E+03	1.870E+03	3.255E+03
78	1.228E+03	-1.813E-35	-2.289E+03	1.759E+03	3.092E+03
79	1.489E+03	2.654E-36	-2.160E+03	1.824E+03	3.178E+03
80	7.798E+02	-9.494E-36	-2.318E+03	1.549E+03	2.791E+03
81	9.956E+02	-2.413E-36	-2.334E+03	1.665E+03	2.961E+03
82	3.832E+02	-4.664E-37	-2.167E+03	1.275E+03	2.381E+03
83	5.762E+02	-4.547E-36	-2.258E+03	1.417E+03	2.594E+03
84	3.598E+01	-1.812E-36	-1.941E+03	9.883E+02	1.959E+03
85	2.019E+02	1.630E-35	-2.057E+03	1.129E+03	2.165E+03
86	-2.170E+02	-4.554E-37	-1.740E+03	8.702E+02	1.643E+03
87	-1.075E+02	-4.348E-36	-1.830E+03	9.150E+02	1.779E+03
88	-2.777E+02	-8.064E-36	-1.689E+03	8.445E+02	1.569E+03
89	-2.777E+02	-8.064E-36	-1.689E+03	8.445E+02	1.569E+03
90	-1.075E+02	-4.348E-36	-1.830E+03	9.150E+02	1.779E+03
91	-2.170E+02	-4.554E-37	-1.740E+03	8.702E+02	1.643E+03
92	1.211E+02	1.459E-35	-1.982E+03	1.051E+03	2.045E+03
93	3.598E+01	-1.812E-36	-1.941E+03	9.883E+02	1.959E+03
158	-2.575E+03	-6.653E-35	-7.679E+03	3.839E+03	6.769E+03
160	-2.851E+03	1.002E-35	-8.118E+03	4.059E+03	7.134E+03
161	-2.669E+03	3.167E-37	-7.905E+03	3.952E+03	6.965E+03
162	-3.166E+03	-2.954E-36	-8.448E+03	4.224E+03	7.392E+03
163	-3.019E+03	5.943E-35	-8.301E+03	4.151E+03	7.270E+03
164	-3.368E+03	5.288E-34	-8.606E+03	4.303E+03	7.511E+03
165	-3.286E+03	3.473E-35	-8.552E+03	4.276E+03	7.472E+03
166	-3.381E+03	9.847E-35	-8.533E+03	4.266E+03	7.443E+03
167	-3.404E+03	8.842E-34	-8.602E+03	4.301E+03	7.504E+03
168	-3.108E+03	-7.207E-36	-8.159E+03	4.079E+03	7.132E+03
169	-3.287E+03	5.710E-35	-8.388E+03	4.194E+03	7.321E+03
170	-2.430E+03	2.409E-35	-7.404E+03	3.702E+03	6.537E+03
171	-2.828E+03	4.894E-35	-7.834E+03	3.917E+03	6.871E+03
172	-1.212E+03	-5.877E-35	-6.196E+03	3.098E+03	5.688E+03
173	-1.897E+03	-3.987E-35	-6.861E+03	3.430E+03	6.136E+03
174	6.719E+02	-4.171E-35	-4.496E+03	2.584E+03	4.867E+03
175	-3.592E+02	3.925E-35	-5.407E+03	2.703E+03	5.236E+03



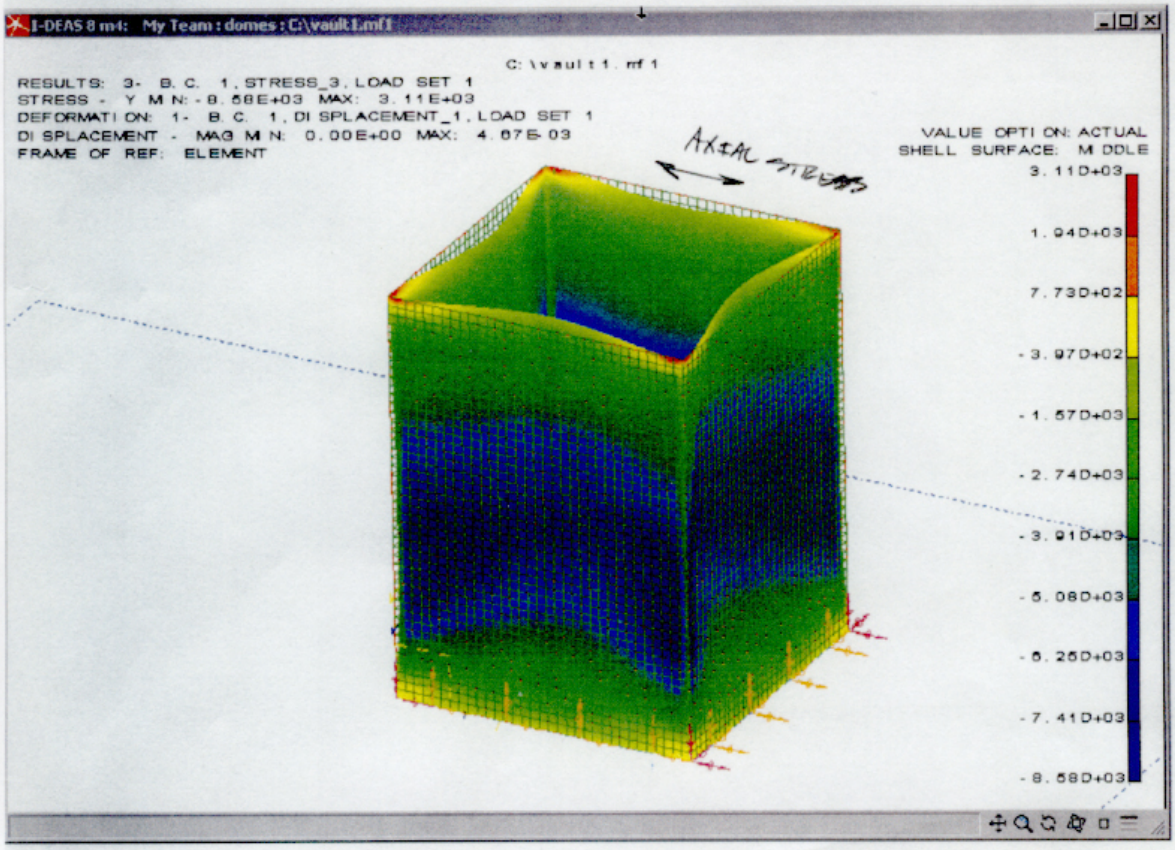
3140	3.771E+03	-1.015E-34	-1.464E+03	2.617E+03	4.678E+03
3143	2.948E+03	-7.316E-37	-1.825E+03	2.386E+03	4.171E+03
3144	2.353E+03	-6.073E-36	-2.767E+03	2.560E+03	4.439E+03
3145	1.737E+03	-5.521E-34	-3.718E+03	2.727E+03	4.827E+03
3148	2.809E+03	1.858E-35	-2.513E+03	2.661E+03	4.611E+03
3149	1.884E+03	-8.948E-36	-3.556E+03	2.720E+03	4.784E+03
3150	3.536E+03	-2.700E-37	-1.074E+03	2.305E+03	4.178E+03
3151	3.795E+03	-3.535E-36	-3.962E+02	2.095E+03	4.008E+03
3152	5.398E+03	4.795E-36	2.237E+02	2.699E+03	5.290E+03
3153	4.739E+03	1.373E-36	-5.070E+02	2.623E+03	5.012E+03
3154	2.787E+03	-3.002E-37	-1.611E+03	2.199E+03	3.854E+03
3155	2.874E+03	1.552E-36	-1.124E+03	1.999E+03	3.571E+03
3158	1.446E+03	1.764E-36	-2.300E+03	1.873E+03	3.272E+03
3160	1.705E+03	5.749E-35	-2.368E+03	2.037E+03	3.543E+03
3161	1.318E+03	-3.720E-35	-2.555E+03	1.937E+03	3.411E+03
3162	1.132E+03	-5.099E-37	-2.420E+03	1.776E+03	3.144E+03
3163	1.812E+03	8.476E-37	-2.067E+03	1.939E+03	3.361E+03
3165	9.819E+02	-1.456E-36	-2.643E+03	1.813E+03	3.248E+03
3178	-3.456E+02	-1.030E-35	-2.235E+03	1.118E+03	2.084E+03
3179	-9.461E+01	1.631E-35	-2.107E+03	1.053E+03	2.061E+03
3188	1.420E+02	-1.316E-36	-2.513E+03	1.328E+03	2.587E+03
3189	3.530E+02	1.370E-34	-2.350E+03	1.351E+03	2.545E+03
3190	5.947E+02	-5.064E-36	-2.426E+03	1.510E+03	2.772E+03
3191	4.027E+02	2.816E-36	-2.606E+03	1.504E+03	2.829E+03
3192	-1.065E+02	-2.889E-36	-2.387E+03	1.193E+03	2.335E+03
3193	1.236E+02	-9.388E-36	-2.240E+03	1.182E+03	2.304E+03
3194	-8.019E+02	-1.053E-35	-1.881E+03	9.407E+02	1.635E+03
3195	-1.010E+03	7.532E-36	-1.691E+03	8.455E+02	1.475E+03
3196	-4.894E+02	-4.886E-36	-1.811E+03	9.053E+02	1.622E+03
3197	-5.773E+02	-2.572E-36	-2.065E+03	1.032E+03	1.845E+03
3198	-6.478E+02	-6.855E-37	-1.677E+03	8.383E+02	1.464E+03
3199	-3.006E+02	6.007E-36	-1.960E+03	9.799E+02	1.828E+03
3302	-5.773E+02	-2.572E-36	-2.065E+03	1.032E+03	1.845E+03
3303	-3.006E+02	6.007E-36	-1.960E+03	9.799E+02	1.828E+03
3316	-1.010E+03	7.532E-36	-1.691E+03	8.455E+02	1.475E+03
3317	-6.478E+02	-6.855E-37	-1.677E+03	8.383E+02	1.464E+03
3318	-7.467E+02	-7.244E-36	-1.589E+03	7.946E+02	1.377E+03
3319	-1.207E+03	-9.876E-37	-1.513E+03	7.567E+02	1.386E+03
3320	-8.019E+02	-1.053E-35	-1.881E+03	9.407E+02	1.635E+03
3321	-4.894E+02	-4.886E-36	-1.811E+03	9.053E+02	1.622E+03
3326	-4.544E+02	-4.812E-36	-2.143E+03	1.072E+03	1.956E+03
3329	-1.936E+02	1.301E-36	-2.021E+03	1.011E+03	1.932E+03
	5	167	5	5	5
Maximum	1.024E+04	8.842E-34	1.163E+03	5.121E+03	9.714E+03
	167	3145	164	2907	2904
Minimum	-3.404E+03	-5.521E-34	-8.606E+03	7.567E+02	1.377E+03

AXIAL FORCE MAX

-8.58E3 psf OR OVER 2.5' TILE & 1.7 FACTOR

OK

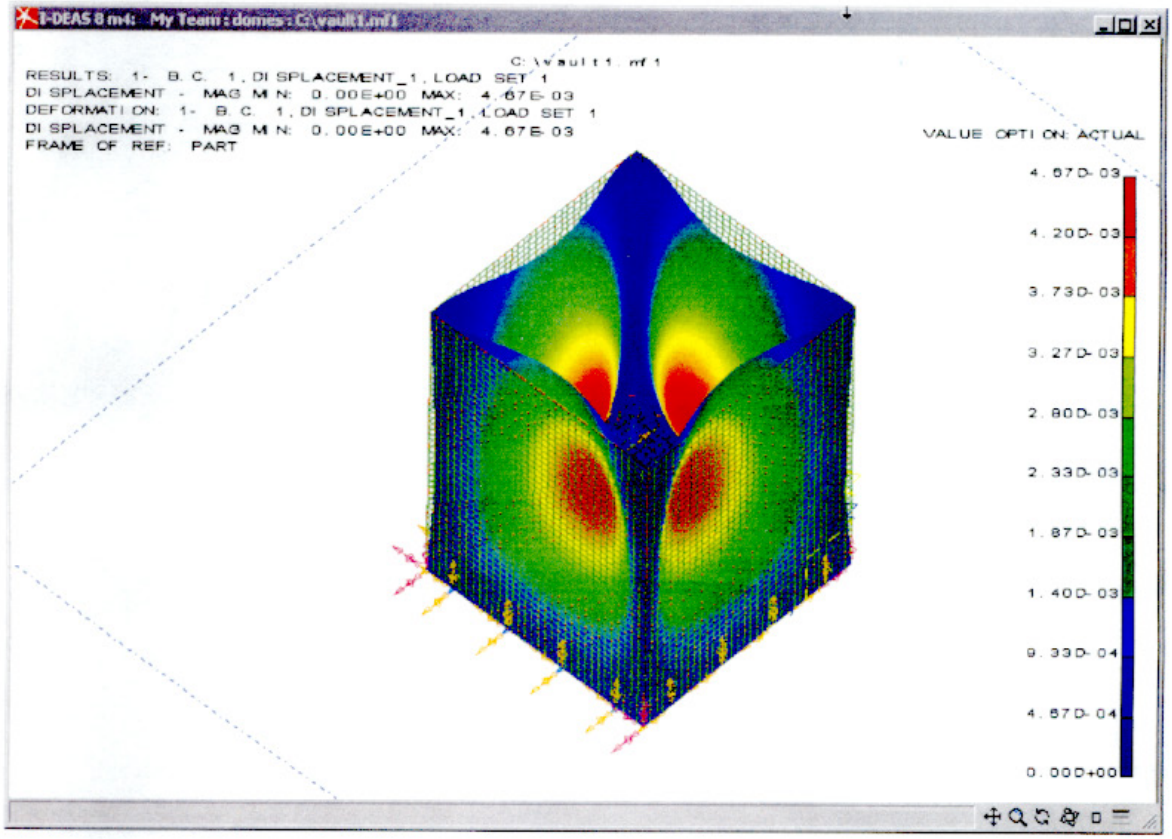
P= 36,465 #/1



MAX DISPLACEMENT

4.67E-3 FT

OR 0.06 IN



STEEL CHECK

$f_c' = 3$ KSI $d = 30in - 2in - \frac{1.5in}{2} = 27.25in$

$f_y = 40$ KSI $b = 12in$

HORIZONTAL

OUTSIDE FACE

WORST CASE @ MID HEIGHT → $M_u = 143.3$ K-ft ← (FEA CALCS, SEE ATTACHED PAGES)

$A_{S_{REQ}} = 1.84 in^2/ft$

$A_{S_{ACTUAL}} = 2.08 in^2/ft$ ← OK #11 AT 9" O.C.

INSIDE FACE

$M_u = 73.2$ K-ft ← (FEA CALCS, SEE ATTACHED PAGES)

WORST CASE @ MID HEIGHT & MID SPAN. → $A_{S_{REQ}} = .92 in^2/ft$

$A_{S_{ACTUAL}} = 1.05 in^2/ft$ ← OK #8 AT 9" O.C.

VERTICAL

OUTSIDE FACE

$M_u = 99.3$ K-ft ← (FEA CALCS, SEE ATTACHED PAGES)

$A_{S_{REQ}} = 1.25 in^2/ft$

$A_{S_{ACTUAL}} = .75 in^2/ft$ ← #9 AT 16" O.C. (OVER STRESSED) ← OK, SEE NOTE

NOTE: ADDITIONAL LOAD TAKEN IN HORIZONTAL STEEL
$\phi M_n = 160$ K-ft AT BASE OF CONCRETE VAULT
& $M_u = 14$ K-ft (ALSO SEE INTERACTION DIAGRAM) PAGE #76

INSIDE FACE

$M_u = 29.8$ K-ft ← (FEA CALCS, SEE ATTACHED PAGES)

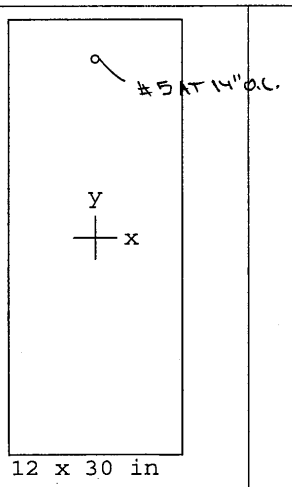
VERTICAL STEEL OK ← SEE INTERACTION DIAGRAM (PAGE #75)

SHEAR

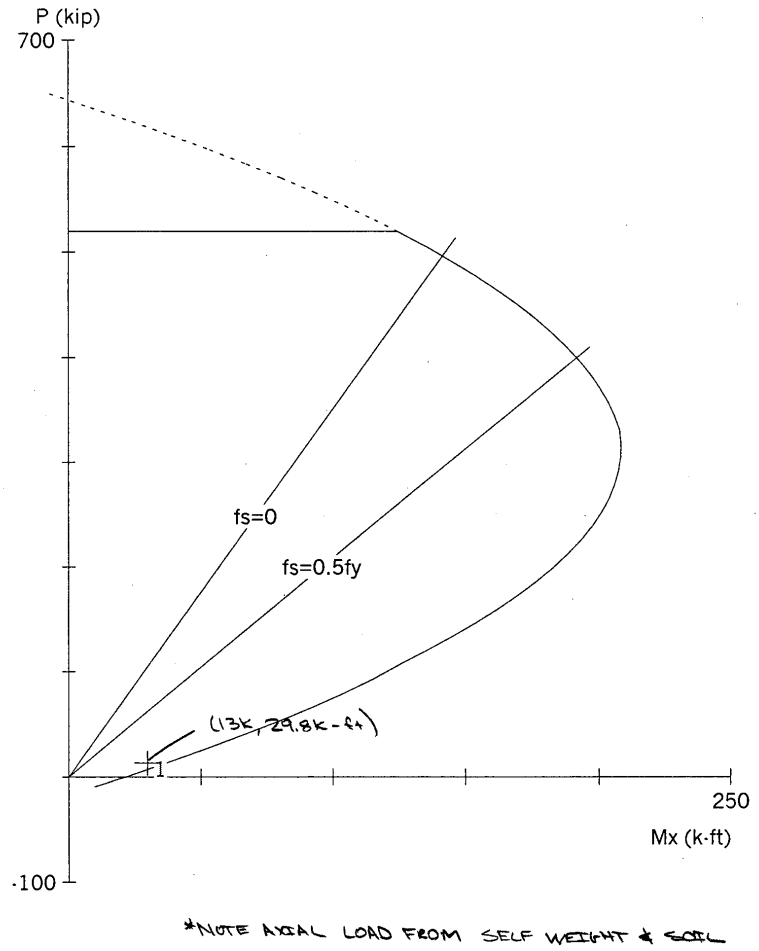
$V_u = 29.9$K ← (FEA CALCS, SEE ATTACHED PAGES)

$\phi V_c = \phi 2 b d \sqrt{f_c'} = .85(2)(12in)(27.25in)\sqrt{3000psi} = 30.45k$ ← OK

Project Name:	Project #:	Initials:	Date:	Sheet: 74



Code: ACI 318-95
Units: English
Run axis: About X-axis
Run option: Investigation
Slenderness: Not considered
Column type: Structural
Bars: ASTM A615
Date: 04/30/03
Time: 14:58:48



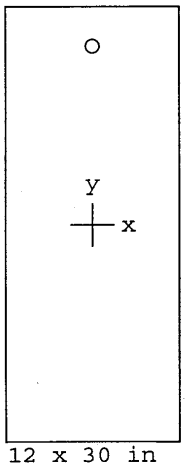
*NOTE AXIAL LOAD FROM SELF WEIGHT & SOIL

PCACOL V3.00 (PCA 1999) - Licensed to:

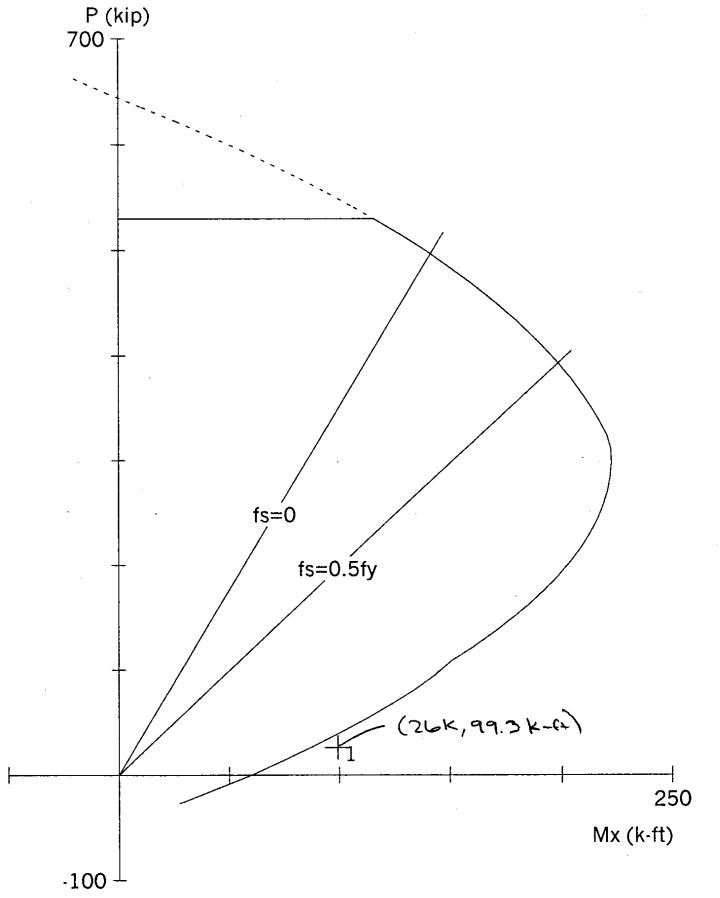
File: untitled.col
Project: Storage Vaults
Column: Vault#1 Engineer: MB

f'c = 3 ksi	fy = 40 ksi	Ag = 360 in^2	1 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 0.27 in^2	Rho = 0.07%
fc = 2.55 ksi	e_rup = Infinity	Xo = 0.00 in	Ix = 27000 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 4320 in^4
Beta1 = 0.85		Clear spacing = 11.9	Clear cover = 2.46 in

Confinement: Tied phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.7



Code: ACI 318-95
Units: English
Run axis: About X-axis
Run option: Investigation
Slenderness: Not considered
Column type: Structural
Bars: ASTM A615
Date: 04/30/03
Time: 15:00:17



*NOTE AXIAL LOAD FROM SELF WEIGHT & SOIL

PCACOL V3.00 (PCA 1999) - Licensed to:

File: untitled.col
Project: Storage Vaults
Column: Vault#1 Engineer: MB

f'c = 3 ksi	fy = 40 ksi	Ag = 360 in^2	1 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 0.75 in^2	Rho = 0.21%
fc = 2.55 ksi	e_rup = Infinity	Xo = 0.00 in	Ix = 27000 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 4320 in^4
Beta1 = 0.85		Clear spacing = 11.7	Clear cover = 2.26 in

Confinement: Tied phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.7

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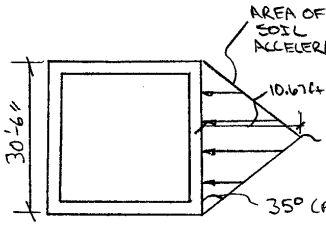
ACTIVE PRESSURE + SEISMIC ANALYSIS (1.7PL(.75)+1.0E)



$\gamma = 120$ pcf

SEISMIC ACCELERATION = .243
FACTOR (SEE SEISMIC LATERAL ANALYSIS; ULTIMATE STRENGTH)

DUE TO SEISMIC → $W = 10.67ft + (120pcf)(.124) = 159plf$

W_a = ~~1850~~ psf ← SEE PREVIOUS CALCS
= 50 pcf (41') .75 = 1538 psf
@ ¼ ht

LOAD COMBINATION

WORST CASE (ACTIVE + SEISMIC) → $W_{u\ TOTAL} = 1538\ plf(.75)(1.7) + 159\ plf = 2120\ plf$ ← OK, LESS THAN ACTIVE PRESSURE

WORST CASE (ACTIVE PRESSURE ONLY) → $W_u = 1538plf(1.7) = 2615\ plf$

SUMMARY → ACTIVE PRESSURE + SEISMIC PRESSURE LESS THAN ACTIVE PRESSURE, SEE CALCS

CONCRETE SHEARWALL ANALYSIS

SIMPLIFIED DESIGN

WALL MARK : **Typical Wall (Vault #1)**

FLEXURAL ANALYSIS :

WALL GEOMETRY & PROPERTIES :

wall length, l_w :	30	ft	c / l_w :	0.24757	
wall thickness, h :	30	in	β_1 :	0.85	
wall height, ht:	0	ft			
fy :	60	ksi	ω :	0.35	
f'c :	3	ksi	α :	0	
ϕ :	0.9				
steel ea. face(Y/N):	n				

LOADS :

WALL LOADING = .1283 (2,460 psf)(15ft)(40ft)^2/2 (1.7)
2050

P_u :	0	k			
M_u :	6438	k*ft	ϕM_n :	12913.7 k*ft	OK

REINFORCING :

A_{st} :	15.94	in^2			

USE : # 5 @ 7 oc vert.

Vert. reinf. must not be less than the horz.

SHEAR ANALYSIS :

LOADS :

Siesmic Zone 3 or 4 (Y/N):	n				
ρ:	1.0				
V_u :	1286.0	k			
$\rho * V_u$:	1286.0	k			
Hook edge reinforcement					
Use two mats of reinforcing					

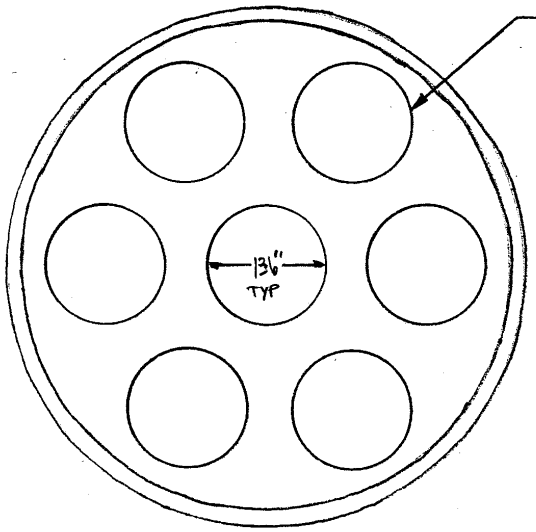
SHEAR STRENGTH :

WALL LOADING = 1.7 (2,460 psf)(15ft)(40ft)/2
2050

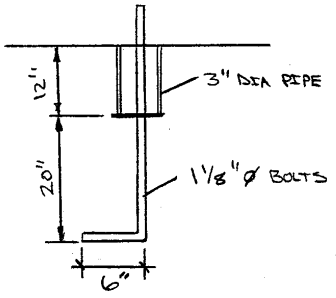
ϕ :	0.85			
ϕV_c :	804.49	k		
ϕV_s :	1516.8	k		
ϕV_n :	2321.3	k		Ok
Min steel:	0.72	in^2/ft		
USE :	# 8 @ 9 oc hor.			OK

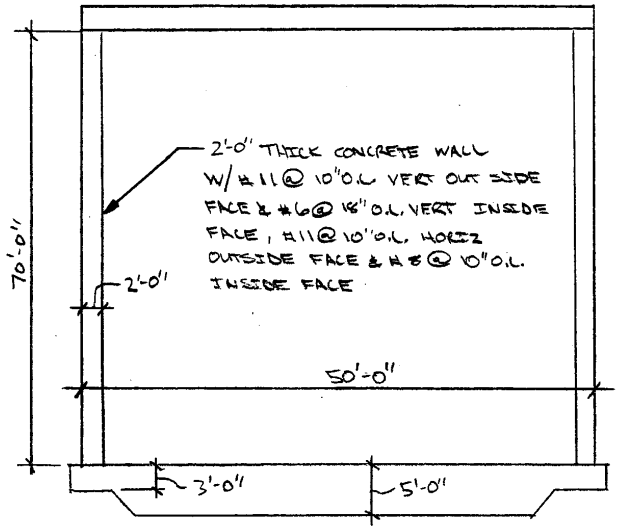
SUMMARY → WALLS PERPENDICULAR TO LOAD ARE OK FOR SHEAR TRANSFER

BIN #2 (VAULT #2)



ANCHOR BOLTS





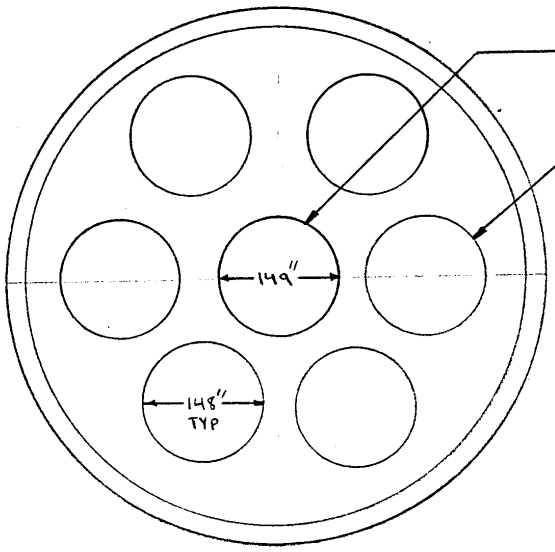
PROPERTIES

REBAR → INTERMEDIATE GRADE
CONCRETE → f'_c = 4,000 psi

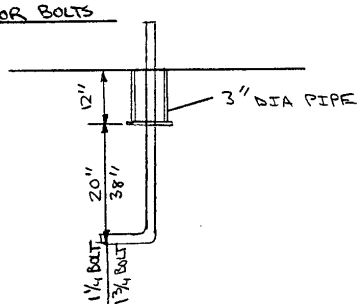
SAME AS VAULT #3

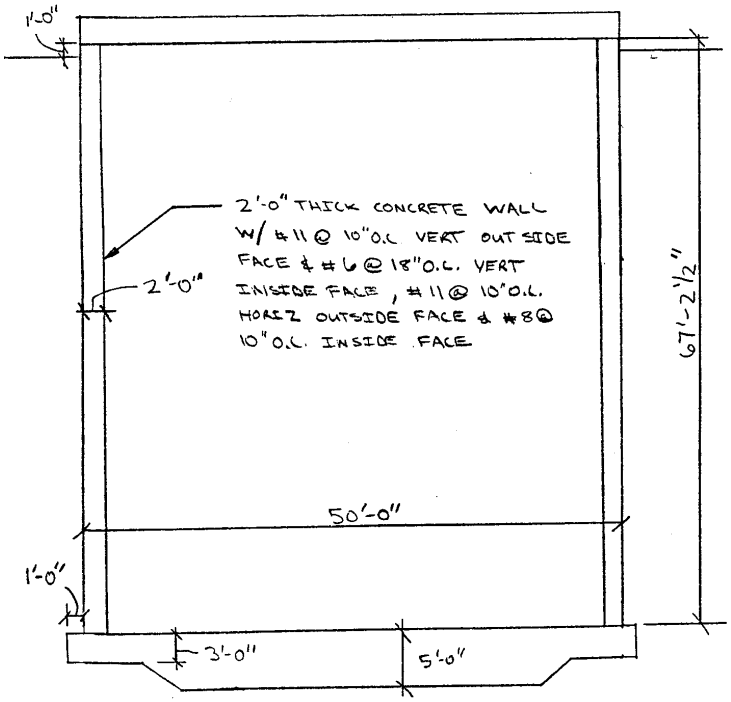
Project Name:	Project #:	Initials:	Date:	Sheet: 80

BIN #3 (VAULT #3)



ANCHOR BOLTS





PROPERTIES

REBAR → INTERMEDIATE GRADE

CONCRETE → NOT SPECIFIED
ASSUME f'_c = 3000 psi

SEE ATTACHED PAGES FOR CONCRETE VAULT CALCS

Project Name:	Project #:	Initials:	Date:	Sheet: 81

ANALYSIS OF CONCRETE VAULTS. (CYL. ONLY.)
SHAPE

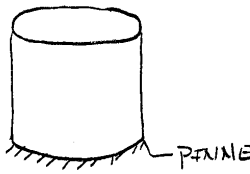
- IN CONCRETE VAULTS 2-7. VAULT 3 IS CONSIDERED A WORST CASE CONDITION. VAULT 2 IS SIMILAR TO VAULT 3, DIFFERENCES ARE NEGLIGIBLE. VAULT 5 IS BIGGER THAN #3 BUT NOT BURIED AS DEEP & THE WALLS ARE 2X THICK. VAULT 4 IS SMALLER & NOT BURIED AS DEEP. THEREFORE VAULT #3 IS ANALYZED AS A WORST CASE CONDITION.

CONCRETE VAULT # 3

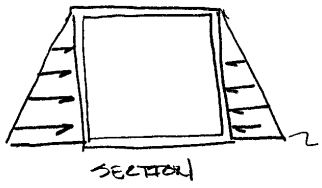
ANALYSIS OF CONCRETE BUNKERS IS CONSIDERED BY THE FOLLOWING:

ANALYSIS TYPE - CLOSED FORM MEMBRANE & FLEXURE ANALYSIS

- BOUNDARY CONDITIONS

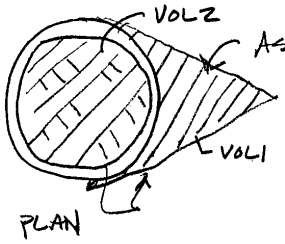


DL = SELF WT.



EXTERNAL P LOAD

$= \gamma q_c H$ COMPARE TO JANSSEN(EQ)
* CONSERVATIVE



EARTHQUAKE LOAD

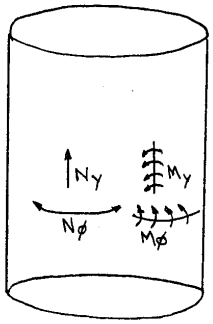
ASSUME PARTICIPATING MASS OF SOIL TO STRUCTURE EQ TO VOL. DENSITY.

ASSUME VOL1 = VOL2 · 90%

Project Name:	Project #:	Initials:	Date:	Sheet: 83

CONCRETE VAULT #3

ANALYSIS (SEE ATTACHED SHEETS FOR VALUES)



$f_c = 3ksi$ $d = 21.25in$

$f_y = 60ksi$ $b = 12in$

LOAD CASE #1 (DL+PL)

VERTICAL STEEL CHECK

$M_u = M_\phi = 5.56k\text{-}ft$

$V_u = N_y = 26.8K$

(LOAD CASE #2 GOVERNS SEE BELOW)

HORIZONTAL STEEL CHECK

$M_u = M_y = 32.7k\text{-}ft$

$V_u = N_\phi = 101.99K$

(LOAD CASE #2 GOVERNS SEE BELOW

LOAD CASE #2 (.75DL+.75PL+E)

VERTICAL STEEL CHECK

$M_u = M_\phi + .75M_{\phi\,(LOAD\ CASE\ \#1)} = 3.1k\text{-}ft + .75(5.56k\text{-}ft) = 7.27k\text{-}ft$

$V_u = N_y + .75N_{y\,(LOAD\ CASE\ \#1)} = 26.88K + .75(26.88K) = 47K$

(SEE ATTACHED CALC FOR CAPACITY CHECK)

HORIZONTAL STEEL CHECK

$M_u = M_y + .75M_{y\,(LOAD\ CASE\ \#1)} = 18.24k\text{-}ft + .75(32.7k\text{-}ft) = 42.76k\text{-}ft$

$V_u = N_\phi + .75N_{\phi\,(LOAD\ CASE\ \#1)} = 96.78K + .75(101.99K) = 173.3K$

(SEE ATTACHED CALC FOR CAPACITY CHECK)

Project Name:	Project #:	Initials:	Date:	Sheet: 84

PEN #3 CONCRETE

VOL = $46^2 \pi/4$ 66' = 113009 FT^3

MASS = 120 pcf ASSUME 13561156 lbs

MASS OF CON. CYL & TOP

TOP $50^2 \pi/4$ (13' 150pcf = 294,525 lb

CYL 48' π 68' 150 pcf = 3076254.72 lb
x2'

- CONSIDER SEISMIC SOIL EFFECTS BY ASSUMING PARTICIPATING MASS OF CYL EXT. = TO CYL FULL OF FILL.

DETERMINE ACC FACTOR

$32.2 / 3.07 \text{ MIL lbs} = X / (13.5)3.07$ X = 145.47 FT/S^2

CONSIDER 80% PER ACI 313

SEISMIC ACC (0.243) ULTIMATE (97 UBC) see note below

⇒ (0.243) 145.47 FT/S^2 = 35.34 FT/S^2

NOTE ⇒ SEISMIC ACC. USED 0.243, WHICH IS CONSERVATIVE. ACTUAL ACCELERATION FACTOR FOR 2000 IBC IS .124 (SEE SEISMIC LATERAL ANALYSIS)

Project Name:	Project #:	Initials:	Date:	Sheet: 85

PROJECT DESCRIPTION : : INEEL BIN CHECK

TITLE : CONCRETE VAULT #3 (SHORT FORM) → LONG FORM IN BACK
DATE : 10/14/02

==========

=
*** INPUT DATA AND CALCULATED PROPERTIES OF STRUCTURE ***
=

==========

NOTE : THE BASE OF THE TANK WALL IS HINGED.

CYLINDER GEOMETRY :

WALL HEIGHT	=	68.00 FT
CYLINDER RADIUS	=	25.00 FT
WALL THICKNESS	=	24.00 IN
FLOOR THICKNESS	=	.00 IN
VOLUME UNDER THE CYLINDERICAL TANK	=	.1335E+06 CU.FT

CONCRETE PROPERTIES :

UNIT WEIGHT OF CONCRETE	=	210.00 PCF ← ULTIMATE LOAD 150 pcf (1.7)
POISSONS RATIO	=	.1700
COMPRESSIVE STRENGTH OF CONCRETE	=	3000.00 PSI
VOLUME OF CONCRETE SHELL	=	791.22 CU.YD
VOLUME OF CONCRETE FLOOR	=	.00 CU.YD
YOUNGS MODULUS OF ELASTICITY	=	.5501E+07 PSI

PROPERITES OF GRANULAR :

DEPTH OF GRANULAR	=	68.00 FT
VOLUME OF GRANULAR	=	133517.60 CU-FT
SPECIFIC WEIGHT OF GRANULAR (GAMMA)	=	-102.00PCF ← ULTIMATE LOAD .5(120pcf)(1.7)

SEISMIC LOADING :

MAX. PRESSURE OF SEISMIC SHEAR ON SHELL	=	460.96 PSF
HORIZONTAL SEISMIC ACCELERATION	=	35.34 FT/SQ.SEC ← ULTIMATE LOAD (SEE ATTACHED CALC)
ACCELERATION OF GRAVITY	=	32.20 FT/SQ.SEC
RELATIVE ACCELERATION (a/g)	=	1.10

THERE IS NO EXTERNAL PRESTRESSING LOAD.

CONSTANT VALUE OF (BETA) = .18E+00 1/FT

***** TOTAL FORCES AT SHELL WALL WITHOUT PRESTRESS *****

==========

==========

HEIGHT(TOP-BOT)	N-THETA	MOM-THETA	N-Y	MOM-Y	SHEAR-Y
FEET	K/FT.	FT.K/FT	K/FT	FT.K/FT	K/FT

LOAD CASE # 3 DL + EQL

68.0	.00	.000	.00	.000	.0000
67.0	.00	.000	-.42	.000	-.0001
66.0	.00	.000	-.84	.000	-.0001
65.0	.00	.000	-1.26	.000	-.0001
64.0	.00	.000	-1.68	.000	-.0001
63.0	.00	.000	-2.10	.000	-.0001
62.0	.00	.000	-2.52	.001	-.0001
61.0	.00	.000	-2.94	.001	-.0002
60.0	.00	.000	-3.36	.001	-.0002
59.0	.00	.000	-3.78	.001	-.0002
58.0	.00	.000	-4.20	.001	-.0002
57.0	.00	.000	-4.62	.001	-.0001
56.0	.00	.000	-5.04	.001	-.0001
55.0	.00	.000	-5.46	.001	.0000
54.0	.00	.000	-5.88	.001	.0002
53.0	.01	.000	-6.30	.001	.0003
52.0	.01	.000	-6.72	.001	.0006
51.0	.01	.000	-7.14	.000	.0008
50.0	.01	.000	-7.56	-.001	.0012
49.0	.01	.000	-7.98	-.002	.0016
48.0	.01	-.001	-8.40	-.004	.0020
47.0	.01	-.001	-8.82	-.006	.0025
46.0	.01	-.002	-9.24	-.009	.0030
45.0	.01	-.002	-9.66	-.012	.0034
44.0	.01	-.003	-10.08	-.016	.0038
43.0	.00	-.003	-10.50	-.020	.0040
42.0	.00	-.004	-10.92	-.024	.0040
41.0	-.01	-.005	-11.34	-.028	.0037
40.0	-.03	-.005	-11.76	-.031	.0029
39.0	-.04	-.006	-12.18	-.034	.0015
38.0	-.06	-.006	-12.60	-.034	-.0006
37.0	-.09	-.005	-13.02	-.032	-.0037
36.0	-.12	-.004	-13.44	-.026	-.0078
35.0	-.15	-.003	-13.86	-.016	-.0130
34.0	-.18	.000	-14.28	.000	-.0196
33.0	-.21	.004	-14.70	.024	-.0275
32.0	-.24	.009	-15.12	.056	-.0367
31.0	-.27	.017	-15.54	.097	-.0470
30.0	-.28	.025	-15.96	.150	-.0580
29.0	-.27	.036	-16.38	.213	-.0691
28.0	-.24	.049	-16.80	.288	-.0796
27.0	-.18	.063	-17.22	.372	-.0882
26.0	-.07	.079	-17.64	.463	-.0934
25.0	.09	.095	-18.06	.557	-.0932
24.0	.32	.110	-18.48	.647	-.0854

23.0	.62	.123	-18.90	.724	-.0670
22.0	1.00	.132	-19.32	.776	-.0349
21.0	1.48	.134	-19.74	.788	.0144
20.0	2.05	.126	-20.16	.741	.0845
19.0	2.70	.104	-20.58	.611	.1791
18.0	3.42	.063	-21.00	.373	.3013
17.0	4.19	.000	-21.42	-.002	.4533
16.0	4.95	-.092	-21.84	-.544	.6361
15.0	5.65	-.218	-22.26	-1.284	.8483
14.0	6.19	-.382	-22.68	-2.249	1.0857
13.0	6.47	-.588	-23.10	-3.461	1.3401
12.0	6.35	-.838	-23.52	-4.930	1.5982
11.0	5.65	-1.131	-23.94	-6.652	1.8404
10.0	4.17	-1.461	-24.36	-8.597	2.0396
9.0	1.69	-1.820	-24.78	-10.705	2.1605
8.0	-2.04	-2.189	-25.20	-12.877	2.1579
7.0	-7.27	-2.543	-25.62	-14.962	1.9770
6.0	-14.24	-2.847	-26.04	-16.750	1.5529
5.0	-23.16	-3.054	-26.46	-17.962	.8115
4.0	-34.16	-3.101	-26.88	-18.240	-.3279
3.0	-47.28	-2.915	-27.30	-17.145	-1.9497
2.0	-62.37	-2.406	-27.72	-14.153	-4.1364
1.0	-79.09	-1.472	-28.14	-8.660	-6.9609
.0	-96.78	.000	-28.56	.000	-10.4765

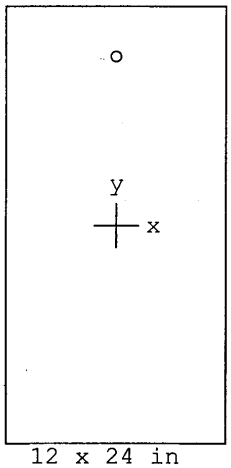
***** TOTAL FORCES AT SHELL WALL WITHOUT PRESTRESS *****

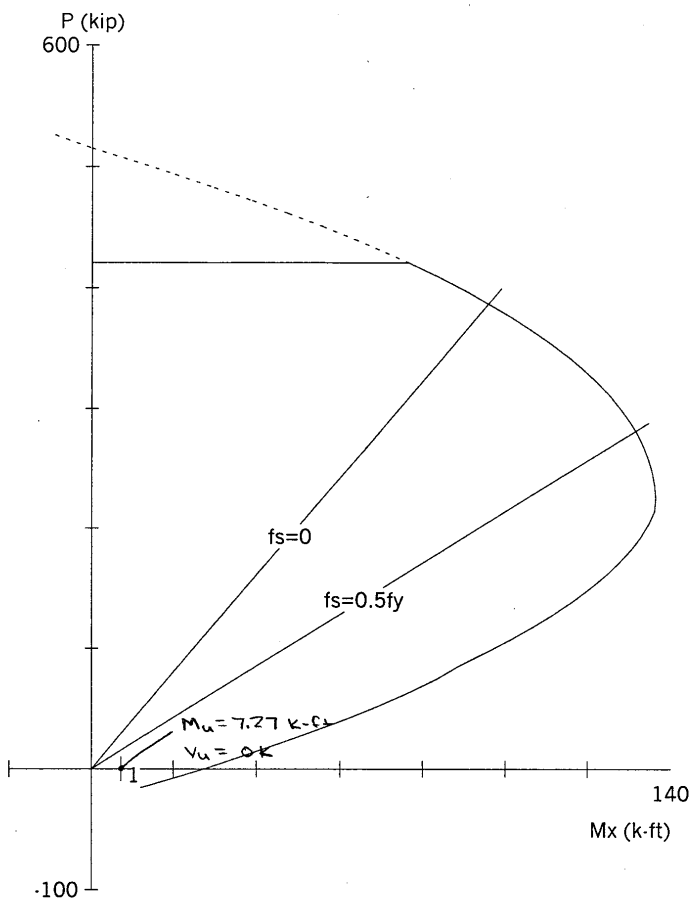
HEIGHT(TOP-BOT)	N-THETA	MOM-THETA	N-Y	MOM-Y	SHEAR-Y
FEET	K/FT.	FT.K/FT	K/FT	FT.K/FT	K/FT

LOAD CASE # 4 DL + FL/GR

68.0	.00	.000	.00	.000	.0001
67.0	-2.55	.000	-.42	.000	.0001
66.0	-5.10	.000	-.84	.000	.0001
65.0	-7.65	.000	-1.26	.000	.0002
64.0	-10.20	.000	-1.68	-.001	.0002
63.0	-12.75	.000	-2.10	-.001	.0002
62.0	-15.30	.000	-2.52	-.001	.0003
61.0	-17.85	.000	-2.94	-.001	.0003
60.0	-20.40	.000	-3.36	-.002	.0003
59.0	-22.95	.000	-3.78	-.002	.0003
58.0	-25.50	.000	-4.20	-.002	.0003
57.0	-28.05	.000	-4.62	-.002	.0002
56.0	-30.60	.000	-5.04	-.003	.0001
55.0	-33.15	.000	-5.46	-.003	.0000

54.0	-35.71	.000	-5.88	-.002	-.0003
53.0	-38.26	.000	-6.30	-.002	-.0006
52.0	-40.81	.000	-6.72	-.001	-.0010
51.0	-43.36	.000	-7.14	.000	-.0015
50.0	-45.92	.000	-7.56	.002	-.0021
49.0	-48.47	.001	-7.98	.004	-.0028
48.0	-51.02	.001	-8.40	.008	-.0036
47.0	-53.57	.002	-8.82	.012	-.0045
46.0	-56.12	.003	-9.24	.017	-.0054
45.0	-58.67	.004	-9.66	.022	-.0062
44.0	-61.21	.005	-10.08	.029	-.0068
43.0	-63.76	.006	-10.50	.036	-.0072
42.0	-66.29	.007	-10.92	.043	-.0072
41.0	-68.83	.009	-11.34	.050	-.0066
40.0	-71.35	.010	-11.76	.056	-.0052
39.0	-73.87	.010	-12.18	.060	-.0027
38.0	-76.39	.010	-12.60	.061	.0011
37.0	-78.89	.010	-13.02	.057	.0066
36.0	-81.39	.008	-13.44	.047	.0139
35.0	-83.88	.005	-13.86	.029	.0234
34.0	-86.38	.000	-14.28	.000	.0351
33.0	-88.87	-.007	-14.70	-.042	.0493
32.0	-91.36	-.017	-15.12	-.100	.0657
31.0	-93.87	-.030	-15.54	-.174	.0841
30.0	-96.40	-.046	-15.96	-.268	.1038
29.0	-98.96	-.065	-16.38	-.382	.1238
28.0	-101.56	-.088	-16.80	-.516	.1425
27.0	-104.23	-.113	-17.22	-.666	.1580
26.0	-106.97	-.141	-17.64	-.829	.1673
25.0	-109.81	-.170	-18.06	-.998	.1671
24.0	-112.76	-.197	-18.48	-1.159	.1530
23.0	-115.85	-.221	-18.90	-1.297	.1201
22.0	-119.10	-.236	-19.32	-1.391	.0626
21.0	-122.50	-.240	-19.74	-1.412	-.0258
20.0	-126.06	-.226	-20.16	-1.327	-.1515
19.0	-129.78	-.186	-20.58	-1.095	-.3209
18.0	-133.63	-.114	-21.00	-.669	-.5398
17.0	-137.55	.000	-21.42	.003	-.8122
16.0	-141.47	.166	-21.84	.974	-1.1396
15.0	-145.27	.391	-22.26	2.300	-1.5199
14.0	-148.79	.685	-22.68	4.029	-1.9452
13.0	-151.85	1.054	-23.10	6.200	-2.4010
12.0	-154.17	1.502	-23.52	8.833	-2.8634
11.0	-155.47	2.026	-23.94	11.918	-3.2973
10.0	-155.37	2.618	-24.36	15.403	-3.6543
9.0	-153.47	3.261	-24.78	19.180	-3.8708
8.0	-149.34	3.922	-25.20	23.071	-3.8663
7.0	-142.52	4.557	-25.62	26.806	-3.5421
6.0	-132.58	5.102	-26.04	30.010	-2.7822
5.0	-119.15	5.471	-26.46	32.181	-1.4540
4.0	-101.99	5.556	-26.88	32.680	.5874
3.0	-81.05	5.222	-27.30	30.718	3.4931
2.0	-56.56	4.311	-27.72	25.356	7.4109
1.0	-29.16	2.638	-28.14	15.515	12.4715
.0	.00	.000	-28.56	.000	18.7702





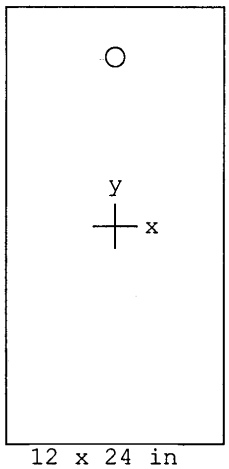
Code: ACI 318-95
Units: English
Run axis: About X-axis
Run option: Investigation
Slenderness: Not considered
Column type: Structural
Bars: ASTM A615
Date: 10/17/02
Time: 14:06:08

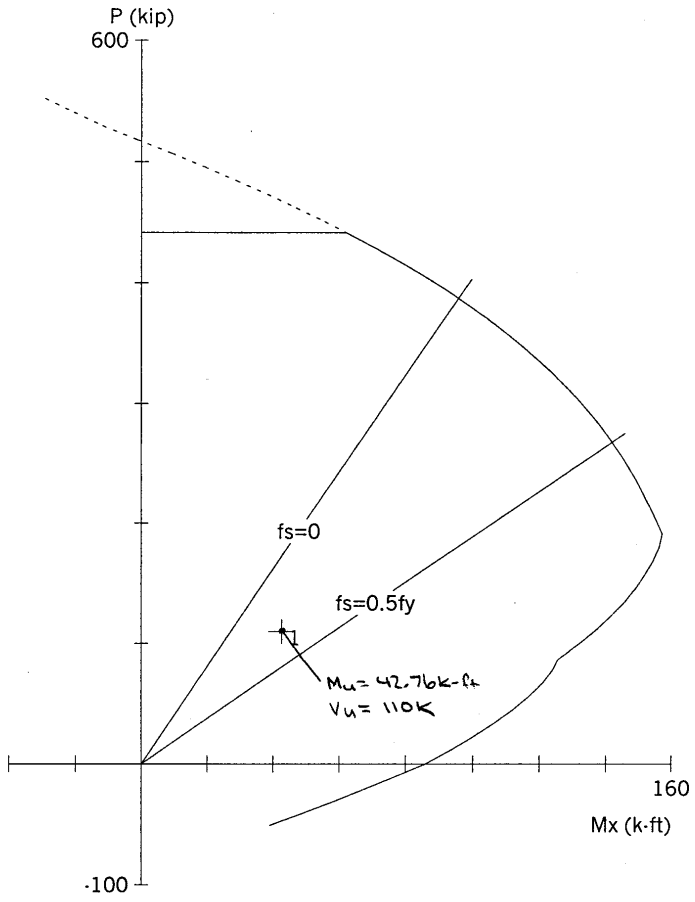
PCACOL V3.00 (PCA 1999) - Licensed to:

File: untitled.col
Project: INEEL BIN CHECK

Column: Vault #3 (VERTICAL STEEL)		Engineer: MB	#6 AT 12" O.C.
f'c = 3 ksi	fy = 60 ksi	Ag = 288 in^2	1 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 0.29 in^2	Rho = 0.10%
fc = 2.55 ksi	e_rup = Infinity	Xo = 0.00 in	Ix = 13824 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3456 in^4
Beta1 = 0.85		Clear spacing = 8.95	Clear cover = 2.45 in

Confinement: Tied phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.7





Code: ACI 318-95
Units: English
Run axis: About X-axis
Run option: Investigation
Slenderness: Not considered
Column type: Structural
Bars: ASTM A615
Date: 10/17/02
Time: 14:05:22

PCACOL V3.00 (PCA 1999) - Licensed to:

File: untitled.col
Project: INEEL BIN CHECK

Column: Vault #3 (HORIZONTAL STEEL)		Engineer: MB	#8 AT 10"O.C.
f'c = 3 ksi	fy = 60 ksi	Ag = 288 in^2	1 bars
Ec = 3122 ksi	Es = 29000 ksi	As = 0.94 in^2	Rho = 0.33%
fc = 2.55 ksi	e_rup = Infinity	Xo = 0.00 in	Ix = 13824 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3456 in^4
Beta1 = 0.85		Clear spacing = 8.70	Clear cover = 2.20 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.7		

CONCRETE VAULT #3 (CONTINUED)

STEEL CHECK

SEE ATTACHED CALCS

SHEAR CHECK

$V_u = 18.71(.75) + 10.47 = 24.55K$

$V_c = \phi 2bd\sqrt{f'c} = .85(2)(12in)(21.25in)\sqrt{3000} = 23.7K$ ← OK, SEISMIC ACCELERATION REDUCED BY 50%, BY INSPECTION OK. (see note pg 85)

SUMMARY → HORIZONTAL & VERTICAL REINFORCEMENT ARE OK & SHEAR IS OKAY

Project Name:	Project #:	Initials:	Date:	Sheet: 91-b

CONCRETE SHEARWALL ANALYSIS

SIMPLIFIED DESIGN

WALL MARK : **Typical Wall (Vault #3)**

FLEXURAL ANALYSIS :

WALL GEOMETRY & PROPERTIES :

wall length, l_w :	35	ft	c / l_w :	0.39834	
wall thickness, h :	24	in	β_1 :	0.85	
wall height, ht:	67	ft			
fy :	60	ksi	ω :	0.24	
f'c :	3	ksi	α :	0.2381	
ϕ :	0.9				
steel ea. face(Y/N):	Y				

LOADS :

NEGLECT, TAKEN IN HOOP STRESS

P_u :	600	k			
M_u :	0	k*ft	ϕM_n :	15387.7 k*ft	OK

REINFORCING :

A_{st} : 10.27 in^2

USE : # 6 @ 18 oc vert. Vert. reinf. must not be less than the horz.

Minimum requirements not met

SHEAR ANALYSIS :

LOADS :

Siesmic Zone 3 or 4 (Y/N):	n	
p:	1.0	
V_u :	2048.0	k
$\rho * V_u$:	2048.0	k

,243 (8,300 k)

Hook edge reinforcement

Use two mats of reinforcing

SHEAR STRENGTH :

ϕ :	0.85		
ϕV_c :	750.86	k	
ϕV_s :	1592.6	k	
ϕV_n :	2343.5	k	Ok
Min steel:	0.576	in^2/ft	

USE : # 8 @ 10 oc hor. OK

SUMMARY → WALLS PERPENDICULAR TO LOAD ARE OK FOR SHEAR TRANSFER

PROJECT DESCRIPTION : INEEL BIN CHECK

TITLE : CONCRETE VAULT #3 (LONG FORM)
DATE : 10/14/02

=

*** INPUT DATA AND CALCULATED PROPERTIES OF STRUCTURE ***

=

NOTE : THE BASE OF THE TANK WALL IS HINGED.

CYLINDER GEOMETRY :

WALL HEIGHT	=	68.00 FT
CYLINDER RADIUS	=	25.00 FT
WALL THICKNESS	=	24.00 IN
FLOOR THICKNESS	=	.00 IN

VOLUME UNDER THE CYLINDERICAL TANK = .1335E+06 CU.FT

CONCRETE PROPERTIES :

UNIT WEIGHT OF CONCRETE	=	210.00 PCF ← ULTIMATE LOAD 150pcf (1.7)
POISSONS RATIO	=	.1700
COMPRESSIVE STRENGTH OF CONCRETE	=	3000.00 PSI
VOLUME OF CONCRETE SHELL	=	791.22 CU.YD
VOLUME OF CONCRETE FLOOR	=	.00 CU.YD
YOUNGS MODULUS OF ELASTICITY	=	.5501E+07 PSI

PROPERITES OF GRANULAR :

DEPTH OF GRANULAR	=	68.00 FT
VOLUME OF GRANULAR	=	133517.60 CU-FT
SPECIFIC WEIGHT OF GRANULAR (GAMMA)	=	-102.00PCF ← ULTIMATE LOAD .5(120pcf)(1.7)

SEISMIC LOADING :

MAX. PRESSURE OF SEISMIC SHEAR ON SHELL	=	460.96 PSF
HORIZONTAL SEISMIC ACCELERATION	=	35.34 FT/SQ.SEC ← ULTIMATE LOAD (SEE ATTACHED CALC)
ACCELERATION OF GRAVITY	=	32.20 FT/SQ.SEC
RELATIVE ACCELERATION (a/g)	=	1.10

THERE IS NO EXTERNAL PRESTRESSING LOAD.

CONSTANT VALUE OF (BETA) = .18E+00 1/FT

LOAD CASE # 3 DL + EQL

SOLUTIONS FOR CYLIDERICAL TANK :

ERROR >>>

TRANSLATION FORCE ERROR DUE TO MEMBRANE
FORCES (MATERIAL LOADS)(E*D10) = -1209.78 KIPS/FT
ROTATIONAL FORCE ERROR DUE TO MEMBRANE
FORCES (MATERIAL LOADS)(E*D20) = .00 KIPS/FT

CORRECTION >>>

TRANSITIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (HORIZONTAL (E*D11) = 115.48
ROTATIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (HORIZONTAL (E*D12=E*D21) = -21.34
ROTATIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (MOMENT) (E*D22) = 7.88
CORRECTIONAL FORCE (FROM DL AND LL ONLY)(X1)= -10.48 KIPS/FT
CORRECTIONAL FORCE (FROM DL AND LL ONLY)(X2)= .00 FT-KIPS/FT

LOAD CASE # 4 DL + FL/GR

SOLUTIONS FOR CYLIDERICAL TANK :

ERROR >>>

TRANSLATION FORCE ERROR DUE TO MEMBRANE
FORCES (MATERIAL LOADS)(E*D10) = 2167.50 KIPS/FT
ROTATIONAL FORCE ERROR DUE TO MEMBRANE
FORCES (MATERIAL LOADS)(E*D20) = .00 KIPS/FT

CORRECTION >>>

TRANSITIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (HORIZONTAL (E*D11) = 115.48
ROTATIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (HORIZONTAL (E*D12=E*D21) = -21.34
ROTATIONAL DISPLACEMENT AT THE BASE
FROM UNIT FORCES (MOMENT) (E*D22) = 7.88
CORRECTIONAL FORCE (FROM DL AND LL ONLY)(X1)= 18.77 KIPS/FT
CORRECTIONAL FORCE (FROM DL AND LL ONLY)(X2)= .00 FT-KIPS/FT

DL = Forces from dead load
LL = ... live load (Int/Ext fluid,granular)
WL = ... Wind load.
EQL= ..... Seismic load.

N-THETA FOR WL .. is taken at thetha = 75 degree
N-THETA FOR EQL .. is taken at thetha = 180 degree
N-Y FOR WL .. is taken at thetha = 0 degree
N-Y FOR EQL .. is taken at thetha = 0 degree
N-Y,THETA FOR WL .. is taken at thetha = 45 degree
N-Y,THETA FOR EQL.. is taken at thetha = 90 degree

MEMBRANE SOLUTION FOR ALL LOAD CONDITIONS

HEIGHT (FT) (KIPS/FT) FROM TOP-BOT.	N-THETA (KIPS/FT) HOOP			N-Y (KIPS/FT) VERTICAL		N-Y,THETA SHEAR	
	LL	WL	EQL	DL	WL	EQL	WL	EQL
68.0	.000	.000	.000	.000	.000	.000	.000	.000
67.0	-2.550	.000	.000	-.420	.000	.000	.000	.000
66.0	-5.100	.000	.000	-.840	.000	.000	.000	.000
65.0	-7.650	.000	.000	-1.260	.000	.000	.000	.000
64.0	-10.200	.000	.000	-1.680	.000	.000	.000	.000
63.0	-12.750	.000	.000	-2.100	.000	.000	.000	.000
62.0	-15.300	.000	.000	-2.520	.000	.000	.000	.000
61.0	-17.850	.000	.000	-2.940	.000	.000	.000	.000
60.0	-20.400	.000	.000	-3.360	.000	.000	.000	.000
59.0	-22.950	.000	.000	-3.780	.000	.000	.000	.000
58.0	-25.500	.000	.000	-4.200	.000	.000	.000	.000
57.0	-28.050	.000	.000	-4.620	.000	.000	.000	.000
56.0	-30.600	.000	.000	-5.040	.000	.000	.000	.000
55.0	-33.150	.000	.000	-5.460	.000	.000	.000	.000
54.0	-35.700	.000	.000	-5.880	.000	.000	.000	.000
53.0	-38.250	.000	.000	-6.300	.000	.000	.000	.000
52.0	-40.800	.000	.000	-6.720	.000	.000	.000	.000
51.0	-43.350	.000	.000	-7.140	.000	.000	.000	.000
50.0	-45.900	.000	.000	-7.560	.000	.000	.000	.000
49.0	-48.450	.000	.000	-7.980	.000	.000	.000	.000
48.0	-51.000	.000	.000	-8.400	.000	.000	.000	.000
47.0	-53.550	.000	.000	-8.820	.000	.000	.000	.000
46.0	-56.100	.000	.000	-9.240	.000	.000	.000	.000
45.0	-58.650	.000	.000	-9.660	.000	.000	.000	.000
44.0	-61.200	.000	.000	-10.080	.000	.000	.000	.000
43.0	-63.750	.000	.000	-10.500	.000	.000	.000	.000
42.0	-66.300	.000	.000	-10.920	.000	.000	.000	.000
41.0	-68.850	.000	.000	-11.340	.000	.000	.000	.000
40.0	-71.400	.000	.000	-11.760	.000	.000	.000	.000
39.0	-73.950	.000	.000	-12.180	.000	.000	.000	.000
38.0	-76.500	.000	.000	-12.600	.000	.000	.000	.000
37.0	-79.050	.000	.000	-13.020	.000	.000	.000	.000

36.0	-81.600	.000	.000	-13.440	.000	.000	.000	.000
35.0	-84.150	.000	.000	-13.860	.000	.000	.000	.000
34.0	-86.700	.000	.000	-14.280	.000	.000	.000	.000
33.0	-89.250	.000	.000	-14.700	.000	.000	.000	.000
32.0	-91.800	.000	.000	-15.120	.000	.000	.000	.000
31.0	-94.350	.000	.000	-15.540	.000	.000	.000	.000
30.0	-96.900	.000	.000	-15.960	.000	.000	.000	.000
29.0	-99.450	.000	.000	-16.380	.000	.000	.000	.000
28.0	-102.000	.000	.000	-16.800	.000	.000	.000	.000
27.0	-104.550	.000	.000	-17.220	.000	.000	.000	.000
26.0	-107.100	.000	.000	-17.640	.000	.000	.000	.000
25.0	-109.650	.000	.000	-18.060	.000	.000	.000	.000
24.0	-112.200	.000	.000	-18.480	.000	.000	.000	.000
23.0	-114.750	.000	.000	-18.900	.000	.000	.000	.000
22.0	-117.300	.000	.000	-19.320	.000	.000	.000	.000
21.0	-119.850	.000	.000	-19.740	.000	.000	.000	.000
20.0	-122.400	.000	.000	-20.160	.000	.000	.000	.000
19.0	-124.950	.000	.000	-20.580	.000	.000	.000	.000
18.0	-127.500	.000	.000	-21.000	.000	.000	.000	.000
17.0	-130.050	.000	.000	-21.420	.000	.000	.000	.000
16.0	-132.600	.000	.000	-21.840	.000	.000	.000	.000
15.0	-135.150	.000	.000	-22.260	.000	.000	.000	.000
14.0	-137.700	.000	.000	-22.680	.000	.000	.000	.000
13.0	-140.250	.000	.000	-23.100	.000	.000	.000	.000
12.0	-142.800	.000	.000	-23.520	.000	.000	.000	.000
11.0	-145.350	.000	.000	-23.940	.000	.000	.000	.000
10.0	-147.900	.000	.000	-24.360	.000	.000	.000	.000
9.0	-150.450	.000	.000	-24.780	.000	.000	.000	.000
8.0	-153.000	.000	.000	-25.200	.000	.000	.000	.000
7.0	-155.550	.000	.000	-25.620	.000	.000	.000	.000
6.0	-158.100	.000	.000	-26.040	.000	.000	.000	.000
5.0	-160.650	.000	.000	-26.460	.000	.000	.000	.000
4.0	-163.200	.000	.000	-26.880	.000	.000	.000	.000
3.0	-165.750	.000	.000	-27.300	.000	.000	.000	.000
2.0	-168.300	.000	.000	-27.720	.000	.000	.000	.000
1.0	-170.850	.000	.000	-28.140	.000	.000	.000	.000
.0	-173.400	.000	.000	-28.560	.000	.000	.000	.000

SOLUTION OF WALL TANK FOR HOOP FORCES

HEIGHT(TOP-BOT) FEET	MEMBRANE KIPS/FT	CORR.(X1,X2) KIPS/FT	TOTAL FORCE
LOAD CASE # 3 DL + EQL			
68.0	.00	.00	.00
67.0	.00	.00	.00
66.0	.00	.00	.00

65.0	.00	.00	.00
64.0	.00	.00	.00
63.0	.00	.00	.00
62.0	.00	.00	.00
61.0	.00	.00	.00
60.0	.00	.00	.00
59.0	.00	.00	.00
58.0	.00	.00	.00
57.0	.00	.00	.00
56.0	.00	.00	.00
55.0	.00	.00	.00
54.0	.00	.00	.00
53.0	.00	.01	.01
52.0	.00	.01	.01
51.0	.00	.01	.01
50.0	.00	.01	.01
49.0	.00	.01	.01
48.0	.00	.01	.01
47.0	.00	.01	.01
46.0	.00	.01	.01
45.0	.00	.01	.01
44.0	.00	.01	.01
43.0	.00	.00	.00
42.0	.00	.00	.00
41.0	.00	-.01	-.01
40.0	.00	-.03	-.03
39.0	.00	-.04	-.04
38.0	.00	-.06	-.06
37.0	.00	-.09	-.09
36.0	.00	-.12	-.12
35.0	.00	-.15	-.15
34.0	.00	-.18	-.18
33.0	.00	-.21	-.21
32.0	.00	-.24	-.24
31.0	.00	-.27	-.27
30.0	.00	-.28	-.28
29.0	.00	-.27	-.27
28.0	.00	-.24	-.24
27.0	.00	-.18	-.18
26.0	.00	-.07	-.07
25.0	.00	.09	.09
24.0	.00	.32	.32
23.0	.00	.62	.62
22.0	.00	1.00	1.00
21.0	.00	1.48	1.48
20.0	.00	2.05	2.05
19.0	.00	2.70	2.70
18.0	.00	3.42	3.42
17.0	.00	4.19	4.19
16.0	.00	4.95	4.95
15.0	.00	5.65	5.65
14.0	.00	6.19	6.19
13.0	.00	6.47	6.47
12.0	.00	6.35	6.35
11.0	.00	5.65	5.65
10.0	.00	4.17	4.17

9.0	.00	1.69	1.69
8.0	.00	-2.04	-2.04
7.0	.00	-7.27	-7.27
6.0	.00	-14.24	-14.24
5.0	.00	-23.16	-23.16
4.0	.00	-34.16	-34.16
3.0	.00	-47.28	-47.28
2.0	.00	-62.37	-62.37
1.0	.00	-79.09	-79.09
.0	.00	-96.78	-96.78

SOLUTION OF WALL TANK FOR HOOP FORCES

HEIGHT(TOP-BOT) FEET	MEMBRANE KIPS/FT	CORR.(X1,X2) KIPS/FT	TOTAL FORCE
LOAD CASE # 4	DL + FL/GR		
68.0	.00	.00	.00
67.0	-2.55	.00	-2.55
66.0	-5.10	.00	-5.10
65.0	-7.65	.00	-7.65
64.0	-10.20	.00	-10.20
63.0	-12.75	.00	-12.75
62.0	-15.30	.00	-15.30
61.0	-17.85	.00	-17.85
60.0	-20.40	.00	-20.40
59.0	-22.95	.00	-22.95
58.0	-25.50	.00	-25.50
57.0	-28.05	.00	-28.05
56.0	-30.60	.00	-30.60
55.0	-33.15	.00	-33.15
54.0	-35.70	-.01	-35.71
53.0	-38.25	-.01	-38.26
52.0	-40.80	-.01	-40.81
51.0	-43.35	-.01	-43.36
50.0	-45.90	-.02	-45.92
49.0	-48.45	-.02	-48.47
48.0	-51.00	-.02	-51.02
47.0	-53.55	-.02	-53.57
46.0	-56.10	-.02	-56.12
45.0	-58.65	-.02	-58.67
44.0	-61.20	-.01	-61.21
43.0	-63.75	-.01	-63.76
42.0	-66.30	.01	-66.29
41.0	-68.85	.02	-68.83
40.0	-71.40	.05	-71.35
39.0	-73.95	.08	-73.87

38.0	-76.50	.11	-76.39
37.0	-79.05	.16	-78.89
36.0	-81.60	.21	-81.39
35.0	-84.15	.27	-83.88
34.0	-86.70	.32	-86.38
33.0	-89.25	.38	-88.87
32.0	-91.80	.44	-91.36
31.0	-94.35	.48	-93.87
30.0	-96.90	.50	-96.40
29.0	-99.45	.49	-98.96
28.0	-102.00	.44	-101.56
27.0	-104.55	.32	-104.23
26.0	-107.10	.13	-106.97
25.0	-109.65	-.16	-109.81
24.0	-112.20	-.56	-112.76
23.0	-114.75	-1.10	-115.85
22.0	-117.30	-1.80	-119.10
21.0	-119.85	-2.65	-122.50
20.0	-122.40	-3.66	-126.06
19.0	-124.95	-4.83	-129.78
18.0	-127.50	-6.13	-133.63
17.0	-130.05	-7.50	-137.55
16.0	-132.60	-8.87	-141.47
15.0	-135.15	-10.12	-145.27
14.0	-137.70	-11.09	-148.79
13.0	-140.25	-11.60	-151.85
12.0	-142.80	-11.37	-154.17
11.0	-145.35	-10.12	-155.47
10.0	-147.90	-7.47	-155.37
9.0	-150.45	-3.02	-153.47
8.0	-153.00	3.66	-149.34
7.0	-155.55	13.03	-142.52
6.0	-158.10	25.52	-132.58
5.0	-160.65	41.50	-119.15
4.0	-163.20	61.21	-101.99
3.0	-165.75	84.70	-81.05
2.0	-168.30	111.74	-56.56
1.0	-170.85	141.69	-29.16
.0	-173.40	173.40	.00

BENDING SOLUTION FOR THE WALL TANK

VARIABLE HEIGHT (TOP-BOT) FEET	MEMBRANE VERTICAL KIPS/FT	CORR.(X1,X2) MOM - Y KIPS/FT	CORR.(X1,X2) MOM-THETA,Y KIPS/FT	CORR.(X1,X2) SHEAR

LOAD CASE # 3 DL + EQL

68.0	.00	.00	.00	.00
67.0	-.42	.00	.00	.00
66.0	-.84	.00	.00	.00
65.0	-1.26	.00	.00	.00
64.0	-1.68	.00	.00	.00
63.0	-2.10	.00	.00	.00
62.0	-2.52	.00	.00	.00
61.0	-2.94	.00	.00	.00
60.0	-3.36	.00	.00	.00
59.0	-3.78	.00	.00	.00
58.0	-4.20	.00	.00	.00
57.0	-4.62	.00	.00	.00
56.0	-5.04	.00	.00	.00
55.0	-5.46	.00	.00	.00
54.0	-5.88	.00	.00	.00
53.0	-6.30	.00	.00	.00
52.0	-6.72	.00	.00	.00
51.0	-7.14	.00	.00	.00
50.0	-7.56	.00	.00	.00
49.0	-7.98	.00	.00	.00
48.0	-8.40	.00	.00	.00
47.0	-8.82	-.01	.00	.00
46.0	-9.24	-.01	.00	.00
45.0	-9.66	-.01	.00	.00
44.0	-10.08	-.02	.00	.00
43.0	-10.50	-.02	.00	.00
42.0	-10.92	-.02	.00	.00
41.0	-11.34	-.03	.00	.00
40.0	-11.76	-.03	-.01	.00
39.0	-12.18	-.03	-.01	.00
38.0	-12.60	-.03	-.01	.00
37.0	-13.02	-.03	-.01	.00
36.0	-13.44	-.03	.00	-.01
35.0	-13.86	-.02	.00	-.01
34.0	-14.28	.00	.00	-.02
33.0	-14.70	.02	.00	-.03
32.0	-15.12	.06	.01	-.04
31.0	-15.54	.10	.02	-.05
30.0	-15.96	.15	.03	-.06
29.0	-16.38	.21	.04	-.07
28.0	-16.80	.29	.05	-.08
27.0	-17.22	.37	.06	-.09
26.0	-17.64	.46	.08	-.09
25.0	-18.06	.56	.09	-.09
24.0	-18.48	.65	.11	-.09
23.0	-18.90	.72	.12	-.07
22.0	-19.32	.78	.13	-.03
21.0	-19.74	.79	.13	.01
20.0	-20.16	.74	.13	.08
19.0	-20.58	.61	.10	.18
18.0	-21.00	.37	.06	.30
17.0	-21.42	.00	.00	.45
16.0	-21.84	-.54	-.09	.64

15.0	-22.26	-1.28	-.22	.85
14.0	-22.68	-2.25	-.38	1.09
13.0	-23.10	-3.46	-.59	1.34
12.0	-23.52	-4.93	-.84	1.60
11.0	-23.94	-6.65	-1.13	1.84
10.0	-24.36	-8.60	-1.46	2.04
9.0	-24.78	-10.71	-1.82	2.16
8.0	-25.20	-12.88	-2.19	2.16
7.0	-25.62	-14.96	-2.54	1.98
6.0	-26.04	-16.75	-2.85	1.55
5.0	-26.46	-17.96	-3.05	.81
4.0	-26.88	-18.24	-3.10	-.33
3.0	-27.30	-17.15	-2.91	-1.95
2.0	-27.72	-14.15	-2.41	-4.14
1.0	-28.14	-8.66	-1.47	-6.96
.0	-28.56	.00	.00	-10.48

BENDING SOLUTION FOR THE WALL TANK

VARIABLE HEIGHT (TOP-BOT) FEET	MEMBRANE VERTICAL KIPS/FT	CORR.(X1,X2) MOM - Y KIPS/FT	CORR.(X1,X2) MOM-THETA,Y KIPS/FT	CORR.(X1,X2) SHEAR
LOAD CASE # 4 DL + FL/GR				
68.0	.00	.00	.00	.00
67.0	-.42	.00	.00	.00
66.0	-.84	.00	.00	.00
65.0	-1.26	.00	.00	.00
64.0	-1.68	.00	.00	.00
63.0	-2.10	.00	.00	.00
62.0	-2.52	.00	.00	.00
61.0	-2.94	.00	.00	.00
60.0	-3.36	.00	.00	.00
59.0	-3.78	.00	.00	.00
58.0	-4.20	.00	.00	.00
57.0	-4.62	.00	.00	.00
56.0	-5.04	.00	.00	.00
55.0	-5.46	.00	.00	.00
54.0	-5.88	.00	.00	.00
53.0	-6.30	.00	.00	.00
52.0	-6.72	.00	.00	.00
51.0	-7.14	.00	.00	.00
50.0	-7.56	.00	.00	.00
49.0	-7.98	.00	.00	.00

48.0	-8.40	.01	.00	.00
47.0	-8.82	.01	.00	.00
46.0	-9.24	.02	.00	-.01
45.0	-9.66	.02	.00	-.01
44.0	-10.08	.03	.00	-.01
43.0	-10.50	.04	.01	-.01
42.0	-10.92	.04	.01	-.01
41.0	-11.34	.05	.01	-.01
40.0	-11.76	.06	.01	-.01
39.0	-12.18	.06	.01	.00
38.0	-12.60	.06	.01	.00
37.0	-13.02	.06	.01	.01
36.0	-13.44	.05	.01	.01
35.0	-13.86	.03	.00	.02
34.0	-14.28	.00	.00	.04
33.0	-14.70	-.04	-.01	.05
32.0	-15.12	-.10	-.02	.07
31.0	-15.54	-.17	-.03	.08
30.0	-15.96	-.27	-.05	.10
29.0	-16.38	-.38	-.06	.12
28.0	-16.80	-.52	-.09	.14
27.0	-17.22	-.67	-.11	.16
26.0	-17.64	-.83	-.14	.17
25.0	-18.06	-1.00	-.17	.17
24.0	-18.48	-1.16	-.20	.15
23.0	-18.90	-1.30	-.22	.12
22.0	-19.32	-1.39	-.24	.06
21.0	-19.74	-1.41	-.24	-.03
20.0	-20.16	-1.33	-.23	-.15
19.0	-20.58	-1.09	-.19	-.32
18.0	-21.00	-.67	-.11	-.54
17.0	-21.42	.00	.00	-.81
16.0	-21.84	.97	.17	-1.14
15.0	-22.26	2.30	.39	-1.52
14.0	-22.68	4.03	.68	-1.95
13.0	-23.10	6.20	1.05	-2.40
12.0	-23.52	8.83	1.50	-2.86
11.0	-23.94	11.92	2.03	-3.30
10.0	-24.36	15.40	2.62	-3.65
9.0	-24.78	19.18	3.26	-3.87
8.0	-25.20	23.07	3.92	-3.87
7.0	-25.62	26.81	4.56	-3.54
6.0	-26.04	30.01	5.10	-2.78
5.0	-26.46	32.18	5.47	-1.45
4.0	-26.88	32.68	5.56	.59
3.0	-27.30	30.72	5.22	3.49
2.0	-27.72	25.36	4.31	7.41
1.0	-28.14	15.52	2.64	12.47
.0	-28.56	.00	.00	18.77

***** TOTAL FORCES AT SHELL WALL WITHOUT PRESTRESS *****

HEIGHT(TOP-BOT)	N-THETA	MOM-THETA	N-Y	MOM-Y	SHEAR-Y
FEET	K/FT.	FT.K/FT	K/FT	FT.K/FT	K/FT

LOAD CASE # 3 DL + EQL

68.0	.00	.000	.00	.000	.0000
67.0	.00	.000	-.42	.000	-.0001
66.0	.00	.000	-.84	.000	-.0001
65.0	.00	.000	-1.26	.000	-.0001
64.0	.00	.000	-1.68	.000	-.0001
63.0	.00	.000	-2.10	.000	-.0001
62.0	.00	.000	-2.52	.001	-.0001
61.0	.00	.000	-2.94	.001	-.0002
60.0	.00	.000	-3.36	.001	-.0002
59.0	.00	.000	-3.78	.001	-.0002
58.0	.00	.000	-4.20	.001	-.0002
57.0	.00	.000	-4.62	.001	-.0001
56.0	.00	.000	-5.04	.001	-.0001
55.0	.00	.000	-5.46	.001	.0000
54.0	.00	.000	-5.88	.001	.0002
53.0	.01	.000	-6.30	.001	.0003
52.0	.01	.000	-6.72	.001	.0006
51.0	.01	.000	-7.14	.000	.0008
50.0	.01	.000	-7.56	-.001	.0012
49.0	.01	.000	-7.98	-.002	.0016
48.0	.01	-.001	-8.40	-.004	.0020
47.0	.01	-.001	-8.82	-.006	.0025
46.0	.01	-.002	-9.24	-.009	.0030
45.0	.01	-.002	-9.66	-.012	.0034
44.0	.01	-.003	-10.08	-.016	.0038
43.0	.00	-.003	-10.50	-.020	.0040
42.0	.00	-.004	-10.92	-.024	.0040
41.0	-.01	-.005	-11.34	-.028	.0037
40.0	-.03	-.005	-11.76	-.031	.0029
39.0	-.04	-.006	-12.18	-.034	.0015
38.0	-.06	-.006	-12.60	-.034	-.0006
37.0	-.09	-.005	-13.02	-.032	-.0037
36.0	-.12	-.004	-13.44	-.026	-.0078
35.0	-.15	-.003	-13.86	-.016	-.0130
34.0	-.18	.000	-14.28	.000	-.0196
33.0	-.21	.004	-14.70	.024	-.0275
32.0	-.24	.009	-15.12	.056	-.0367
31.0	-.27	.017	-15.54	.097	-.0470
30.0	-.28	.025	-15.96	.150	-.0580
29.0	-.27	.036	-16.38	.213	-.0691
28.0	-.24	.049	-16.80	.288	-.0796
27.0	-.18	.063	-17.22	.372	-.0882
26.0	-.07	.079	-17.64	.463	-.0934
25.0	.09	.095	-18.06	.557	-.0932
24.0	.32	.110	-18.48	.647	-.0854

23.0	.62	.123	-18.90	.724	-.0670
22.0	1.00	.132	-19.32	.776	-.0349
21.0	1.48	.134	-19.74	.788	.0144
20.0	2.05	.126	-20.16	.741	.0845
19.0	2.70	.104	-20.58	.611	.1791
18.0	3.42	.063	-21.00	.373	.3013
17.0	4.19	.000	-21.42	-.002	.4533
16.0	4.95	-.092	-21.84	-.544	.6361
15.0	5.65	-.218	-22.26	-1.284	.8483
14.0	6.19	-.382	-22.68	-2.249	1.0857
13.0	6.47	-.588	-23.10	-3.461	1.3401
12.0	6.35	-.838	-23.52	-4.930	1.5982
11.0	5.65	-1.131	-23.94	-6.652	1.8404
10.0	4.17	-1.461	-24.36	-8.597	2.0396
9.0	1.69	-1.820	-24.78	-10.705	2.1605
8.0	-2.04	-2.189	-25.20	-12.877	2.1579
7.0	-7.27	-2.543	-25.62	-14.962	1.9770
6.0	-14.24	-2.847	-26.04	-16.750	1.5529
5.0	-23.16	-3.054	-26.46	-17.962	.8115
4.0	-34.16	-3.101	-26.88	-18.240	-.3279
3.0	-47.28	-2.915	-27.30	-17.145	-1.9497
2.0	-62.37	-2.406	-27.72	-14.153	-4.1364
1.0	-79.09	-1.472	-28.14	-8.660	-6.9609
.0	-96.78	.000	-28.56	.000	-10.4765

***** TOTAL FORCES AT SHELL WALL WITHOUT PRESTRESS *****

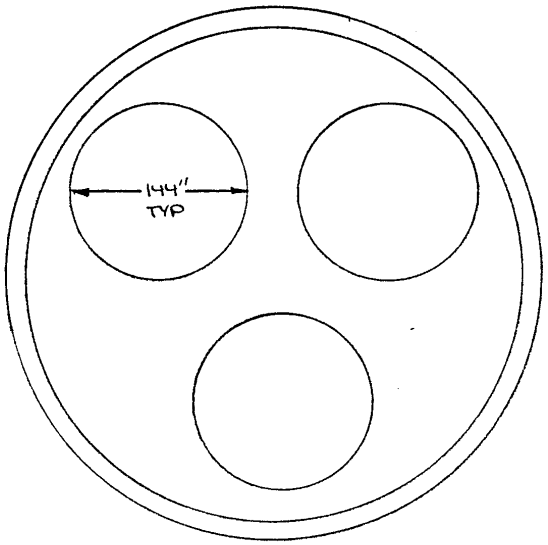
HEIGHT(TOP-BOT)	N-THETA	MOM-THETA	N-Y	MOM-Y	SHEAR-Y
FEET	K/FT.	FT.K/FT	K/FT	FT.K/FT	K/FT

LOAD CASE # 4 DL + FL/GR

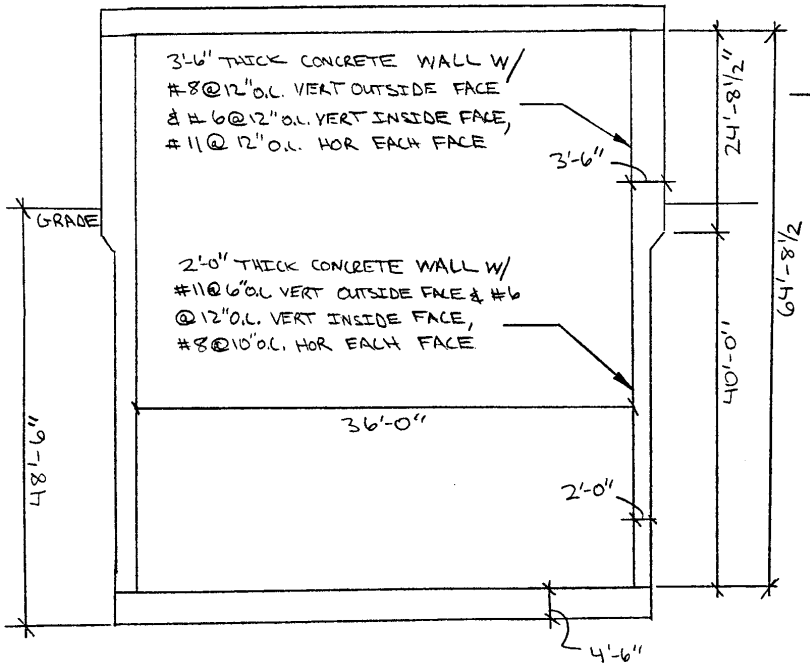
68.0	.00	.000	.00	.000	.0001
67.0	-2.55	.000	-.42	.000	.0001
66.0	-5.10	.000	-.84	.000	.0001
65.0	-7.65	.000	-1.26	.000	.0002
64.0	-10.20	.000	-1.68	-.001	.0002
63.0	-12.75	.000	-2.10	-.001	.0002
62.0	-15.30	.000	-2.52	-.001	.0003
61.0	-17.85	.000	-2.94	-.001	.0003
60.0	-20.40	.000	-3.36	-.002	.0003
59.0	-22.95	.000	-3.78	-.002	.0003
58.0	-25.50	.000	-4.20	-.002	.0003
57.0	-28.05	.000	-4.62	-.002	.0002
56.0	-30.60	.000	-5.04	-.003	.0001
55.0	-33.15	.000	-5.46	-.003	.0000

54.0	-35.71	.000	-5.88	-.002	-.0003
53.0	-38.26	.000	-6.30	-.002	-.0006
52.0	-40.81	.000	-6.72	-.001	-.0010
51.0	-43.36	.000	-7.14	.000	-.0015
50.0	-45.92	.000	-7.56	.002	-.0021
49.0	-48.47	.001	-7.98	.004	-.0028
48.0	-51.02	.001	-8.40	.008	-.0036
47.0	-53.57	.002	-8.82	.012	-.0045
46.0	-56.12	.003	-9.24	.017	-.0054
45.0	-58.67	.004	-9.66	.022	-.0062
44.0	-61.21	.005	-10.08	.029	-.0068
43.0	-63.76	.006	-10.50	.036	-.0072
42.0	-66.29	.007	-10.92	.043	-.0072
41.0	-68.83	.009	-11.34	.050	-.0066
40.0	-71.35	.010	-11.76	.056	-.0052
39.0	-73.87	.010	-12.18	.060	-.0027
38.0	-76.39	.010	-12.60	.061	.0011
37.0	-78.89	.010	-13.02	.057	.0066
36.0	-81.39	.008	-13.44	.047	.0139
35.0	-83.88	.005	-13.86	.029	.0234
34.0	-86.38	.000	-14.28	.000	.0351
33.0	-88.87	-.007	-14.70	-.042	.0493
32.0	-91.36	-.017	-15.12	-.100	.0657
31.0	-93.87	-.030	-15.54	-.174	.0841
30.0	-96.40	-.046	-15.96	-.268	.1038
29.0	-98.96	-.065	-16.38	-.382	.1238
28.0	-101.56	-.088	-16.80	-.516	.1425
27.0	-104.23	-.113	-17.22	-.666	.1580
26.0	-106.97	-.141	-17.64	-.829	.1673
25.0	-109.81	-.170	-18.06	-.998	.1671
24.0	-112.76	-.197	-18.48	-1.159	.1530
23.0	-115.85	-.221	-18.90	-1.297	.1201
22.0	-119.10	-.236	-19.32	-1.391	.0626
21.0	-122.50	-.240	-19.74	-1.412	-.0258
20.0	-126.06	-.226	-20.16	-1.327	-.1515
19.0	-129.78	-.186	-20.58	-1.095	-.3209
18.0	-133.63	-.114	-21.00	-.669	-.5398
17.0	-137.55	.000	-21.42	.003	-.8122
16.0	-141.47	.166	-21.84	.974	-1.1396
15.0	-145.27	.391	-22.26	2.300	-1.5199
14.0	-148.79	.685	-22.68	4.029	-1.9452
13.0	-151.85	1.054	-23.10	6.200	-2.4010
12.0	-154.17	1.502	-23.52	8.833	-2.8634
11.0	-155.47	2.026	-23.94	11.918	-3.2973
10.0	-155.37	2.618	-24.36	15.403	-3.6543
9.0	-153.47	3.261	-24.78	19.180	-3.8708
8.0	-149.34	3.922	-25.20	23.071	-3.8663
7.0	-142.52	4.557	-25.62	26.806	-3.5421
6.0	-132.58	5.102	-26.04	30.010	-2.7822
5.0	-119.15	5.471	-26.46	32.181	-1.4540
4.0	-101.99	5.556	-26.88	32.680	.5874
3.0	-81.05	5.222	-27.30	30.718	3.4931
2.0	-56.56	4.311	-27.72	25.356	7.4109
1.0	-29.16	2.638	-28.14	15.515	12.4715
.0	.00	.000	-28.56	.000	18.7702

BIN #4



SAME AS BIN #3



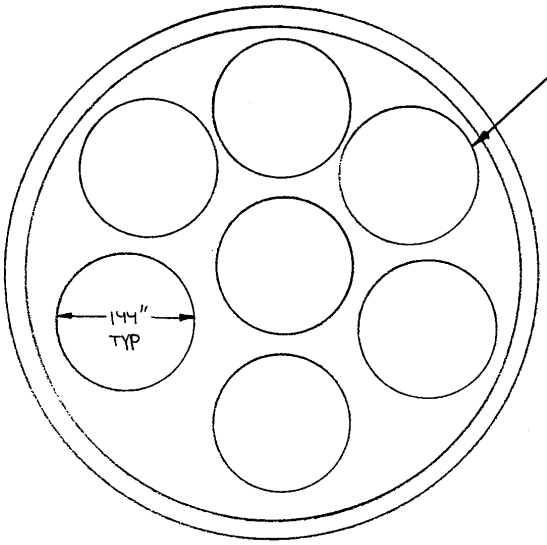
PROPERTIES

REBAR → NOT SPECIFIED
ASSUME f_y = 60ksi

CONCRETE → f_c' = 4000psi

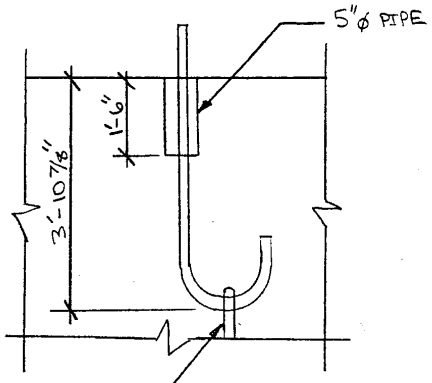
Project Name:	Project #:	Initials:	Date:	Sheet: 106

BIN # 5

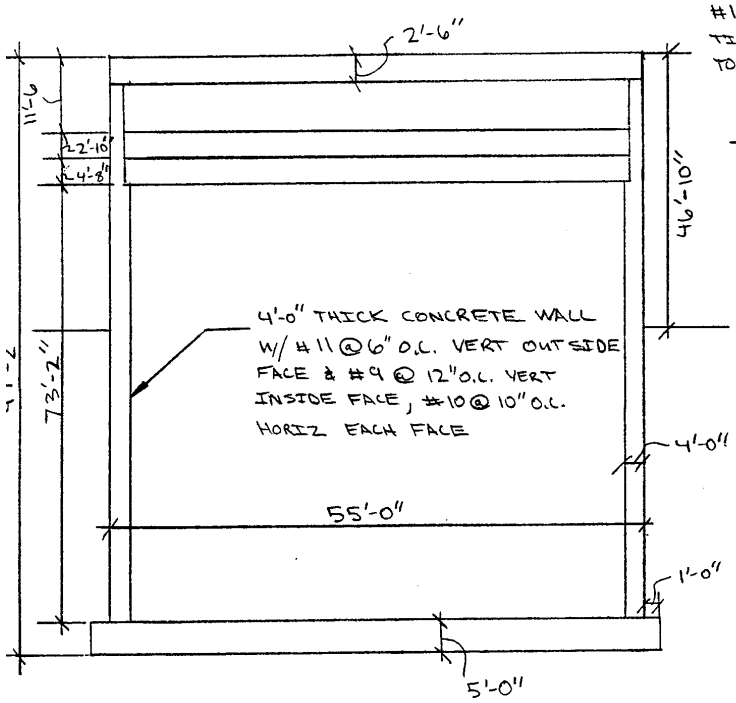


36 - 2 1/4" DIA ANCHORS

ANCHOR BOLTS



#11 BAR TO TIE ANCHOR BOLT TO BOTTOM REINFORCEMENT



PROPERTIES

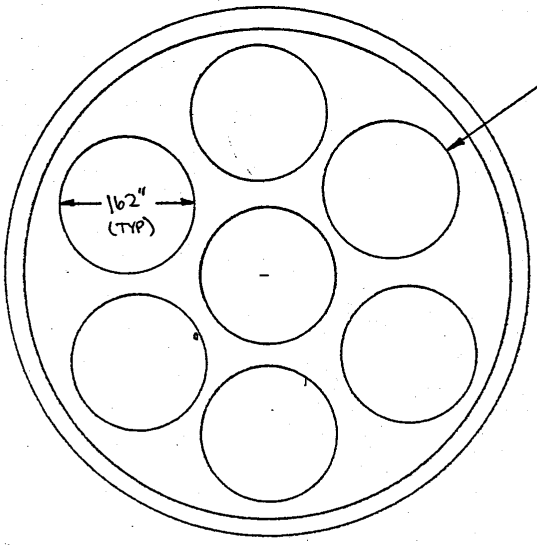
REBAR → NOT SPECIFIED
ASSUME f_y = 60 KSI

CONCRETE → f_c' = 4,000 psi

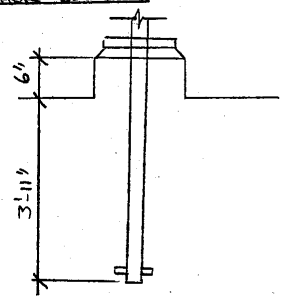
SAME AS BIN #3

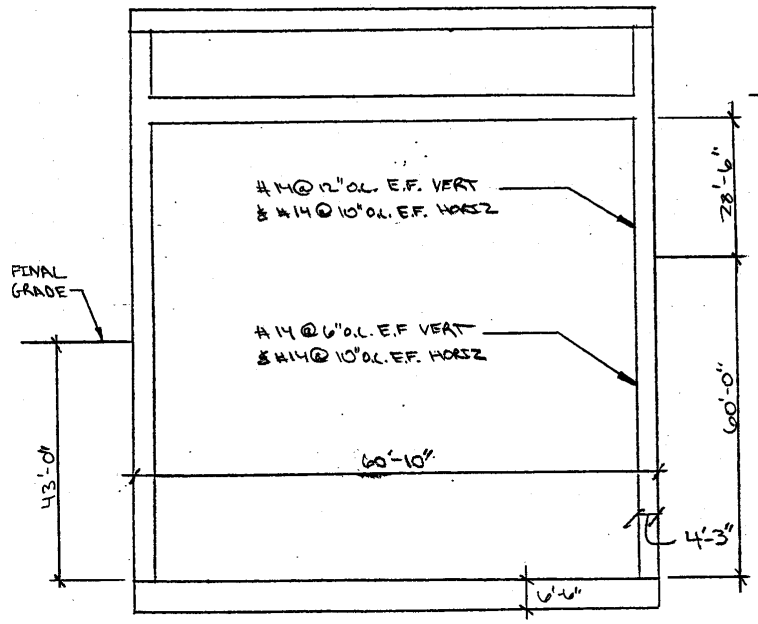
Project Name:	Project #:	Initials:	Date:	Sheet: 107

BIN #6 (VAULT #6)



ANCHOR BOLTS (SAME AS BIN #7)





PROPERTIES

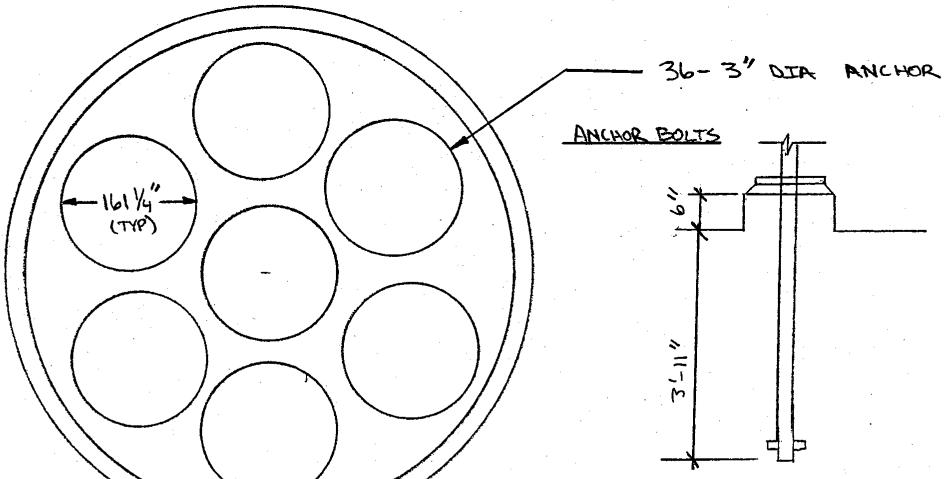
REAR → NOT SPECIFIED
ASSUME f_y = 60 ksi

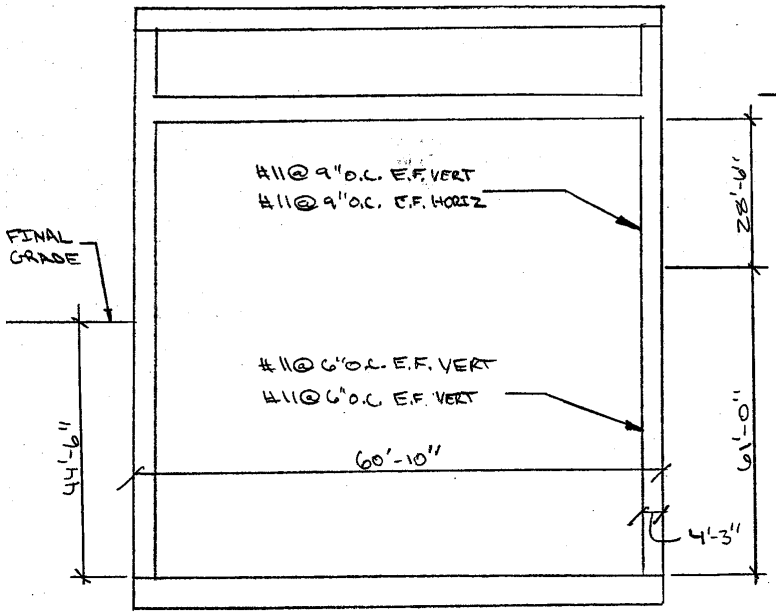
CONCRETE → NOT SPECIFIED
ASSUME f_c = 3,000 psi

SAME AS BIN #3

Project Name:	Project #:	Initials:	Date:	Sheet: 108

BIN #7 (VAULT #7)





PROPERTIES

REBAR → NOT SPECIFIED
ASSUME f_y = 60ksi

CONCRETE → NOT SPECIFIED
ASSUME f_c = 3,000psi

SAME AS BIN #3

Project Name:	Project #:	Initials:	Date:	Sheet: 109

ATTACHMENT B

BIN SET INTEGRITY ASSESSMENT - CORROSION

BY

CORROSION CONTROL SPECIALIST INC.

INEEL

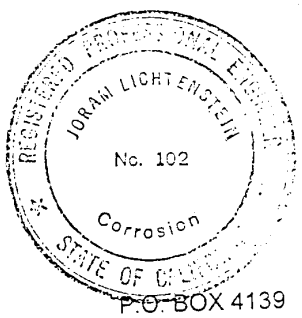
BIN SET INTEGRITY ASSESSMENT - CORROSION

PREPARED BY:

CORROSION CONTROL SPECIALIST INC.



JORAM LICHTENSTEIN, Ph.D., P.E.
REGISTERED PROFESSIONAL ENGINEER
N.A.C.E. CERTIFIED CORROSION SPECIALIST



JULY 2002

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INEEL CALCINE BIN SET - CORROSION EVALUATION

JULY 2002

CORROSION CONTROL SPECIALIST INC. was asked to conduct an evaluation of the corrosion propensity of the bin materials. The work was done under Contract with Jason Associates Corporation, Consultant Agreement No. 02-005-2336 Dated July 2002.

The Scope of Services was described as:

> Existing corrosion protection measures will be evaluated as will the tank (bin) systems compatibility with the waste being stored. The effort will also consider possible (as it is assumed any close inspection is not feasible) tank system conditions as a result of corrosion or potential corrosion and, if there is potential for corrosion, what effect it might have on the structural integrity of the system. That is, the analysis should determine if there are suspected or potential corrosion concerns associated with any of the seven (7) bin sets that could cause them to collapse, rupture, or otherwise fail under their current use. The corrosion engineer will make determinations based primarily on the bin set designs (including the materials of construction) and the characteristics of the materials stored. This information will be provided to the corrosion engineer.

Per discussions with the client, it is assumed that this effort will include consideration of moisture entering the vaults in which the bin sets are located. That is, what effect such moisture might have on the bin sets and would the effect be worsened were any of the stored calcine material to reach the moisture. The deliverable for this element will be a short report, signed and stamped (PE) by the corrosion engineer, summarizing the results of the corrosion analysis. The report should summarize the results of the corrosion engineer's analysis and provide a basis for the findings.

The report should identify existing corrosion protection measures incorporated into the bin sets 1 through 7 (based on their designs) and provide a conclusion on the adequacy of those measures. The corrosion engineer will not perform any evaluation as to the structural integrity of the bins or tanks, nor conduct any leak tests, nor determine the structural strength of the tanks. The corrosion engineer will only carry out a corrosion evaluation based on the materials of construction and content of the tanks, based on information received from the Client.

In accordance with the above Scope of Work, the corrosion propensity of the bins have been reviewed based on the information, reference documents, and drawings that were submitted by Jason Associates Corporation. These references are listed at the end of this report. This report was written based on the information received.

As far as could be determined, the only corrosion control measures taken was the metallurgy, or selection of materials, used for the construction of the bins.

From the data submitted, as well as the bin drawings and several of the referenced reports, the primary material of construction is Stainless Steel, type 304, 304L and 405. One report also mentions coupons made of Type 1025 Carbon Steel, but no reference to a bin manufactured of this type of material was found.

The report stated the following materials of construction:

Bin 1 - Type 405 Stainless Steel

Bin 2-4 - Type 304 Stainless Steel

Bin 5-7 - Type 304L Stainless Steel

The following material of construction paragraph was submitted:

"This information is based on document (referenced in the HLW EIS), Calcine Waste Storage at the Idaho Nuclear Technology and Engineering Center (M. D. Staiger, INEEL/EXT-98-00455, June 1999)(Ref. 5) that provides a summary of construction materials and thicknesses for the bin sets. The construction materials identified in this document are as follows:

Bin Set #1: Type 405 stainless steel
Bin Sets 2, 3, and 4: Type 304 stainless steel
Bin Sets 5 and 6: Type 304L stainless steel
(Bin Set 7 is shown in the drawings as Type 304L stainless steel.)"

The materials stored in these bins are of a dry calcine nature, reportedly containing the following elements:

1. Volume: 3,809 m3 Density: 1.48 g/cm3 (weighted average), which includes:

Zr-based calcine:2,291 m3 at 1.65 g/cm3; and
Al-based calcine: 918 m3 at 1.09 g/cm3
2. Sodium Based Waste (SBW) Calcine and Newly Generated Waste Calcine:
Volume: 577 m3 ; Density: 1.2 g/cm3
(Note: The volume of this type calcine was obtained from the total volume of calcine as of May 2000 per the preliminary HLW FEIS - 4,386 m3 - less the HLW Calcine - 3,809 m3)

From a copy of a document of the HWMA/RCRA Partial Closure of the New Waste Calcine Facility (Calciner System) at the INEEL (DOE/ID-10801, April 2002), which has the following (in its Table 1) as the typical constituents of calcine produced in the last Calciner campaign (March through May 2000):

Aluminum (Al) - 33.4% by weight
Oxygen (O) - 33.2%
Sodium (Na) - 17.0%
Calcium (Ca) - 3.7%
Nitrate (NO3) - 3.6%
Potassium (K) - 3.2%
Sulfate (SO4) - 1.5%
Iron (Fe) - 0.6%
Chloride (Cl) - 0.5%
Zirconium (Zr) - 0.3%
Boron (B) - 0.1%
Cadmium (Cd) - 0.1%
Other - 1.9% (includes radio nuclides and trace components such as Hg, Cr, Ni, etc.)

Some of the referenced documents, (such as Ref.3, Table 4-3, Pg.4-4) have similar lists of calcine composition, most without the Chlorides, but since the Chlorides are the most troublesome element, it was considered in this report. The concentration of Chlorides was also stated in Ref.3 and Ref.5. The 0.5% cited above is the "worse-case" condition. From the corrosion evaluation standpoint, the older and newer calcines are similar in their chemical compositions and their effects on the materials of construction.

None of these materials should effect the integrity of the bin materials as long as they are kept dry.

A question was asked about the corrosion propensity of the materials of construction in the postulated event that moisture enters the vaults in which the bins are located. It is assumed that the question relates to calcined material that has spilled over the side of the bins or otherwise has reached the bins exterior surfaces, and adhered to the exterior surfaces, and combines with moisture in the vault.

The main problem that would be of concern is the presence of wet Chlorides (Cl) which might cause pitting type corrosion of the Stainless Steel, primarily the 405 and to some extent the 304, and to a lesser degree the 304L, and might even cause Stress Corrosion Cracking if stresses are involved.

This is a remote postulation, but should be considered. To prevent such occurrence, the wet contaminated surfaces should immediately be washed with clean water to remove all wet calcine deposits. This issue is a hypothetical one, and although cited by Staiger (Ref. 5) it is a highly unlikely event that the contaminated water levels will be high enough to reach the bins, but it must be considered.

Since the type of corrosion expected under such a circumstances is Pitting, there is no accurate way to predict the time to failure, and "Corrosion Allowance" can not be considered as a reliable line of defense in such a case, even though an allowance was designed into the wall thickness of the bins. Although the pitting resistance of Stainless Steels can be calculated, the formula and the index used were developed for aerated (oxidizing) chloride solutions and the pitting factor is applicable primarily to duplex stainless steel. The pitting factor refers to environments containing chloride solutions, which might only be the case if the chloride containing calcine is wet. It is not possible to properly postulate the pitting propensity of the bins materials under such circumstances.

Several coupon sets were installed in the bins for future corrosion evaluation. One of the referenced reports (Ref.1) cited a test conducted on some of the coupons after about 6 years of service.

The coupons were installed in 1966, and some of them were tested in 1973. The average annual corrosion rate for the type 405 Stainless Steel was 0.014 mils and for the type 304 and 304L Stainless Steel it was 0.003 mils. Based on this corrosion rate, and if the rate remains constant, the projected uniform corrosion rate of the bins in 500 years is 7 mils for type 405 and 2 mils for types 304 and 304L. A later report, dated June 1994, (Ref. 7) reached basically the same conclusion that for uniform corrosion, the corrosion rate is minimal for the next 500 years.

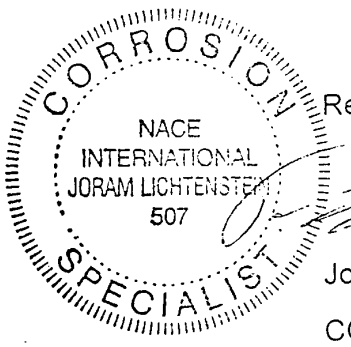
The information and conclusions reached in these referenced documents confirms the theoretical conclusion reached in this report. It must be remembered that this corrosion rate refers to uniform corrosion, and is not applicable in the case of pitting corrosion. Coupon corrosion rate is a tool for predicting uniform corrosion and metal loss, but is not applicable to pitting corrosion.

The corrosion rate of the coupons is a good indication that at present time there is no general corrosion activity effecting the bin materials of construction.

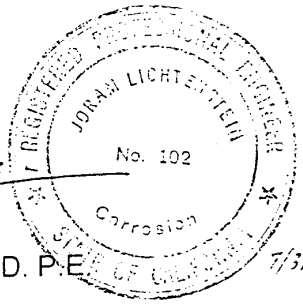
It can be concluded that the integrity of the bins from the uniform corrosion standpoint is sound, and the rate of material losses is negligible. It is recommended, however, that the coupon testing program continues as originally planned, supplemented by visual inspections whenever possible.

Reference Documents:

1. "Corrosion Monitoring of Storage Bins for Radioactive Calcine", Allied Chemical Corp. Oct. 1975 (ICP-1071)
2. "Properties of Radioactive Calcine Retrieved From the Second Calcined Solid Storage Facility at ICPP", Allied Chemicals, March 1979 (ICP-1189)
3. "Inventories and Properties of ICPP Calcined High Level Waste" Westinghouse Idaho Nuclear Co. Feb 1988 (WINCO-1050)
4. "Waste Disposal Options Report" Vol2, INEEL, Feb. 1998 (INEEL/EXT-97-01145)
5. "Calcined Waste Storage at the Idaho Nuclear Technology and Engineering Center" M.D. Staiger, Lockheed Martin, June 1999 (INEEL/EXT-98-00455)
6. "Solids Waste Bins, Specification No. 5775-cpf-p10", Rev. 11-30-60 (AEC Contract AT(10-1)-890
7. "Long Term Laboratory Corrosion Monitoring of Calcine Bin Set Materials Exposed to Zirconia Calcine", WINCO-1219, June1994
8. "Solid Storage Bins Specification No. P-7, CPP-Additional Calcined Waste Storage Facilities", Norman Engineering Co., Dec.11, 1964, AEC Contract AT (10-1) - 1180



Respectfully Submitted,



7/31/02

Joram Lichtenstein, Ph.D. P.E.

CORROSION CONTROL SPECIALIST INC.

ATTACHMENT C

TELEPHONE LOG

Jason Associates Corporation

TELEPHONE LOG,

Date of Telephone Conversation: September 26, 2002
Time of Telephone Conversation: Afternoon
Topic of Discussion: Date of Fabrication for Bins in Bin Sets #6 and #7
Related Action Tracking Number (if any):

Jason Representative for Telephone Call: Keith D. Davis, P.E.

Personnel Involved in Telephone Conversation	Company/Organization Representing
Mr. Mike Swenson (208-526-3576)	INEEL

Summary of Conversation:

Mr. Swenson was contacted earlier with regard to the dates of fabrication for the bins in Bin Sets #6 and #7. These fabrication dates were not contained in the reference (Staiger 1999) from which fabrication dates for the other bins were obtained. When asked if he could obtain the needed dates, Mr. Swenson said he would try and would get back to me. On September 26, 2002, he called me to provide information.

Mr. Swenson indicated he located a drawing from the Mason Steel company of the bins in Bin Set #6. The drawing was labeled Revision 3 and shown as "as-built" on the latest date on the drawing, which was March 21, 1983. Based on the drawing information, Mr. Swenson said it appears that 1983 would be the appropriate date of fabrication for the bins in Bin Set #6.

Mr. Swenson indicated he was unable to locate similar information for Bin Set #7, but he was able to locate design drawings for the Bin Set that were dated April 1985. His guess is that the bins would have been fabricated sometime (maybe 6 to 18 months) afterward. Accordingly, he would assume a fabrication date of 1985 or 1986. Mr. Swenson also said I could probably get a better answer for Bin Set #7 by contacting Mr. Roben Aeschbacher (208-526-9693) who manages engineering design drawings at INTEC. He thought Mr. Aeschbacher would be able to easily call up electronic records based on the vessel numbers that would provide fabrication dates.

Actions Items Stemming from Telephone Conversation	Responsibility
Call Mr. Aeschbacher for fabrication date of the bins in Bin Set #7	Keith Davis, Jason Associates

Appendix 3
Calcine Sample
Analytical Data

RCRA PART B PERMIT REAPPLICATION

FOR THE
IDAHO NATIONAL LABORATORY

VOLUME 22
IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

APPENDIX 3

REPRESENTATIVE CALCINE SAMPLE ANALYTICAL DATA

MAY 2016

Al Calcine VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	71-43-2	Benzene	10	UG/L	UHZ	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	78-93-3	2-Butanone	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	56-23-5	Carbon tetrachloride	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	108-90-7	Chlorobenzene	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	67-66-3	Chloroform	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	75-35-4	1,1-Dichloroethene	10	UG/L	UHZ	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	107-06-2	1,2-Dichloroethane	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	127-18-4	Tetrachloroethene	10	UG/L	UH	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	79-01-6	Trichloroethene	10	UG/L	UHZ	R
CAL0011301TV	3AZ44	ORG	(TCLP VOC)	75-01-4	Vinyl Chloride	10	UG/L	UH	R

Al Calcine Total VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	ANALYSIS	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0012001VG	3AZ51	ORG	(VOC)	71-55-6	1,1,1-Trichloroethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	79-34-5	1,1,2,2-Tetrachloroethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	79-00-5	1,1,2-Trichloroethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-34-3	1,1-Dichloroethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-35-4	1,1-Dichloroethene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	107-06-2	1,2-Dichloroethane	10	UG/KG	UMH	R
CAL0012001VG	3AZ51	ORG	(VOC)	78-87-5	1,2-Dichloropropane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	78-93-3	2-Butanone	10	UG/KG	UMH	R
CAL0012001VG	3AZ51	ORG	(VOC)	591-78-6	2-Hexanone	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	108-10-1	4-Methyl-2-pentanone	27	UG/KG	H	J
CAL0012001VG	3AZ51	ORG	(VOC)	67-64-1	Acetone	10	UG/KG	UHZ	R
CAL0012001VG	3AZ51	ORG	(VOC)	71-43-2	Benzene	20	UG/KG	UHZ	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-27-4	Bromodichloromethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-25-2	Bromoform	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	74-83-9	Bromomethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-15-0	Carbon disulfide	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	56-23-5	Carbon tetrachloride	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	108-90-7	Chlorobenzene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-00-3	Chloroethane	10	UG/KG	UMH	R
CAL0012001VG	3AZ51	ORG	(VOC)	67-66-3	Chloroform	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	74-87-3	Chloromethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	156-59-2	cis-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	10061-01-5	cis-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	124-48-1	Dibromochloromethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	100-41-4	Ethylbenzene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-09-2	Methylene Chloride	20	UG/KG	UHZ	R
CAL0012001VG	3AZ51	ORG	(VOC)	95-47-6	o-Xylene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	100-42-5	Styrene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	127-18-4	Tetrachloroethene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	108-88-3	Toluene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	156-60-5	trans-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	10061-02-6	trans-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	79-01-6	Trichloroethene	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-69-4	Trichlorofluoromethane	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	75-01-4	Vinyl Chloride	10	UG/KG	UH	R
CAL0012001VG	3AZ51	ORG	(VOC)	1330-20-7	Xylene, Isomers m&p	20	UG/KG	UH	R

Al Calcine SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	106-46-7	1,4-Dichlorobenzene	10	UG/L	UHZ	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	121-14-2	2,4-Dinitrotoluene	10	UG/L	UHZ	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	118-74-1	Hexachlorobenzene	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	87-68-3	Hexachlorobutadiene	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	67-72-1	Hexachloroethane	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	95-48-7	2-Methylphenol (o-Cresol)	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	*3&4-METHYLPHENOL	3&4-methylphenol	20	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	98-95-3	Nitrobenzene	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	87-86-5	Pentachlorophenol	10	UG/L	UHZ	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	95-95-4	2,4,5-Trichlorophenol	10	UG/L	UH	R
CAL0011301TA	3AZ44	ORG	(TCLP SVOC)	88-06-2	2,4,6-Trichlorophenol	10	UG/L	UH	R

Al Calcine Total SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	83-32-9	Acenaphthene	200	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	208-96-8	Acenaphthylene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	120-12-7	Anthracene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	103-33-3	Azobenzene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	56-55-3	Benzo(a)anthracene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	205-99-2	Benzo(b)fluoranthene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	207-08-9	Benzo(k)fluoranthene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	191-24-2	Benzo(g,h,i)perylene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	50-32-8	Benzo(a)pyrene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	111-91-1	Bis-(2-chloroethoxy)methane	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	111-44-4	bis-(2-Chloroethyl)ether	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	108-60-1	bis(2-Chloroisopropyl)ether	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	117-81-7	bis-(2-ethylhexyl)phthalate	1000	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	101-55-3	4-Bromophenyl phenyl ether	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	85-68-7	Benzyl butyl phthalate	600	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	86-74-8	Carbazole	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	106-47-8	4-Chloroaniline	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	59-50-7	4-Chloro-3-methylphenol	200	UG/KG	UHZ	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	91-58-7	2-Chloronaphthalene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	95-57-8	2-Chlorophenol	200	UG/KG	UHZ	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	7005-72-3	4-Chlorophenyl phenyl ether	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	218-01-9	Chrysene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	53-70-3	Dibenzo(a,h)anthracene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	132-64-9	Dibenzofuran	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	84-74-2	Di-n-butyl phthalate	800	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	95-50-1	1,2-Dichlorobenzene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	541-73-1	1,3-Dichlorobenzene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	106-46-7	1,4-Dichlorobenzene	200	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	91-94-1	3,3'-Dichlorobenzidine	600	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	120-83-2	2,4-Dichlorophenol	200	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	84-66-2	Diethyl Phthalate	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	105-67-9	2,4-Dimethylphenol	400	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	131-11-3	Dimethyl phthalate	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	534-52-1	4,6-Dinitro-2-methylphenol	400	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	51-28-5	2,4-Dinitrophenol	400	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	121-14-2	2,4-Dinitrotoluene	200	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	606-20-2	2,6-Dinitrotoluene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	117-84-0	Di-n-octyl phthalate	400	UG/KG	UH	UJ

CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	206-44-0	Fluoranthene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	86-73-7	Fluorene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	118-74-1	Hexachlorobenzene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	87-68-3	Hexachlorobutadiene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	77-47-4	Hexachlorocyclopentadiene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	67-72-1	Hexachloroethane	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	193-39-5	Indeno(1,2,3-cd)pyrene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	78-59-1	Isophorone	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	91-57-6	2-Methylnaphthalene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	95-48-7	2-Methylphenol (o-Cresol)	200	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	*3&4-METHYLPHENOL	3&4-methylphenol	400	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	91-20-3	Naphthalene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	88-74-4	2-Nitroaniline	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	99-09-2	3-Nitroaniline	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	100-01-6	4-Nitroaniline	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	98-95-3	Nitrobenzene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	88-75-5	2-Nitrophenol	200	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	100-02-7	4-Nitrophenol	400	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	62-75-9	n-Nitrosodimethylamine	400	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	86-30-6	n-Nitrosodiphenylamine	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	621-64-7	n-Nitrosodi-n-propylamine	200	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	87-86-5	Pentachlorophenol	200	UG/KG	UHZ	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	85-01-8	Phenanthrene	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	108-95-2	Phenol	200	UG/KG	UHZ	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	129-00-0	Pyrene	400	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	110-86-1	Pyridine	400	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	126-73-8	tri-n-butyl phosphate	200	UG/KG	UH	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	120-82-1	1,2,4-Trichlorobenzene	200	UG/KG	UHZ	UJ
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	95-95-4	2,4,5-Trichlorophenol	200	UG/KG	UH	R
CAL0011301SV	3AZ44RA	ORG	(SEMIVOLATILE)	88-06-2	2,4,6-Trichlorophenol	200	UG/KG	UH	R

H3 Calcine Metals Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Analyte	Result	Units	Concentration Qualifier	Lab Flag	Validation Flag
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7429-90-5	Aluminum	4.13E+04	UG/L			
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-36-0	Antimony	4.20E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-38-2	Arsenic	5.30E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-39-3	Barium	5.30E+02	UG/L	B		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-41-7	Beryllium	1.00E+01	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-43-9	Cadmium	5.00E+04	UG/L			
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-70-2	Calcium	6.28E+05	UG/L	B	D	
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-47-3	Chromium	9.33E+03	UG/L			
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-48-4	Cobalt	1.00E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-50-8	Copper	1.60E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-89-6	Iron	5.70E+02	UG/L	B		U
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-92-1	Lead	3.70E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-95-4	Magnesium	5.78E+03	UG/L	B		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-96-5	Manganese	6.00E+01	UG/L	B		U
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-97-6	Mercury	2.70E+01	UG/L	B	N	J
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7439-98-7	Molybdenum	4.20E+02	UG/L	B		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-02-0	Nickel	2.20E+02	UG/L	B		U
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-09-7	Potassium	3.04E+05	UG/L	B		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7782-49-2	Selenium	3.50E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-22-4	Silver	3.20E+02	UG/L	U	N	R
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-23-5	Sodium	1.23E+06	UG/L	B	D	
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-28-0	Thallium	4.90E+02	UG/L	U		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-62-2	Vanadium	1.60E+02	UG/L	B		
CAL0011201TI	3AY20	INORG	(TCLP METALS)	7440-66-6	Zinc	1.90E+02	UG/L	B		U

H3 Calcine Total Metals Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Analyte	Result	Units	Concentration Qualifier	Lab Flag	Validation Flag
CAL0011201XM	3AY20	INORG	(METALS)	7429-90-5	Aluminum	1.35E+05	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-36-0	Antimony	3.93E+01	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-38-2	Arsenic	4.95E+01	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-39-3	Barium	1.15E+02	MG/KG	B		
CAL0011201XM	3AY20	INORG	(METALS)	7440-41-7	Beryllium	9.30E-01	MG/KG	B		U
CAL0011201XM	3AY20	INORG	(METALS)	7440-43-9	Cadmium	2.93E+04	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-70-2	Calcium	2.19E+05	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-47-3	Chromium	9.94E+02	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-48-4	Cobalt	9.30E-00	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-50-8	Copper	1.24E+02	MG/KG	B		U
CAL0011201XM	3AY20	INORG	(METALS)	7439-89-6	Iron	2.08E+03	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7439-92-1	Lead	2.18E+02	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7439-95-4	Magnesium	4.67E+03	MG/KG	B		
CAL0011201XM	3AY20	INORG	(METALS)	7439-96-5	Manganese	8.14E+02	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7439-97-6	Mercury	2.30E-00	MG/KG	U	D	UJ
CAL0011201XM	3AY20	INORG	(METALS)	7439-98-7	Molybdenum	3.08E+02	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-02-0	Nickel	4.66E+02	MG/KG			
CAL0011201XM	3AY20	INORG	(METALS)	7440-09-7	Potassium	4.93E+03	MG/KG	B	N	J
CAL0011201XM	3AY20	INORG	(METALS)	7782-49-2	Selenium	3.37E+01	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-22-4	Silver	3.08E+01	MG/KG	U	N	UJ
CAL0011201XM	3AY20	INORG	(METALS)	7440-23-5	Sodium	2.12E+04	MG/KG	B		
CAL0011201XM	3AY20	INORG	(METALS)	7440-28-0	Thallium	4.71E+01	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-62-2	Vanadium	1.40E+01	MG/KG	U		
CAL0011201XM	3AY20	INORG	(METALS)	7440-66-6	Zinc	6.06E+01	MG/KG	B		U

H3 Calcine VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0010501TV	3AY21	ORG	(TCLP VOC)	75-35-4	1,1-Dichloroethene	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	107-06-2	1,2-Dichloroethane	50	UG/L	UMD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	78-93-3	2-Butanone	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	71-43-2	Benzene	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	56-23-5	Carbon tetrachloride	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	108-90-7	Chlorobenzene	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	67-66-3	Chloroform	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	127-18-4	Tetrachloroethene	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	79-01-6	Trichloroethene	50	UG/L	UD	
CAL0010501TV	3AY21	ORG	(TCLP VOC)	75-01-4	Vinyl Chloride	50	UG/L	UD	

H3 Calcine Total VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0010801VG	3AY24RERE	ORG	(VOC)	71-55-6	1,1,1-Trichloroethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	79-34-5	1,1,2,2-Tetrachloroethane	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	10	UG/KG	UHZ	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	79-00-5	1,1,2-Trichloroethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-34-3	1,1-Dichloroethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-35-4	1,1-Dichloroethene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	107-06-2	1,2-Dichloroethane	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	78-87-5	1,2-Dichloropropane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	78-93-3	2-Butanone	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	591-78-6	2-Hexanone	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	108-10-1	4-Methyl-2-pentanone	260	UG/KG	JMHE	J
CAL0010801VG	3AY24RERE	ORG	(VOC)	67-64-1	Acetone	66	UG/KG	JBHZ	U
CAL0010801VG	3AY24RERE	ORG	(VOC)	71-43-2	Benzene	20	UG/KG	UHZ	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-27-4	Bromodichloromethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-25-2	Bromoform	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	74-83-9	Bromomethane	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-15-0	Carbon disulfide	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	56-23-5	Carbon tetrachloride	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	108-90-7	Chlorobenzene	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-00-3	Chloroethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	67-66-3	Chloroform	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	74-87-3	Chloromethane	10	UG/KG	JBH	U
CAL0010801VG	3AY24RERE	ORG	(VOC)	156-59-2	cis-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	10061-01-5	cis-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	124-48-1	Dibromochloromethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	100-41-4	Ethylbenzene	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-09-2	Methylene Chloride	20	UG/KG	UHZ	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	95-47-6	o-Xylene	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	100-42-5	Styrene	10	UG/KG	UMH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	127-18-4	Tetrachloroethene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	108-88-3	Toluene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	156-60-5	trans-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	10061-02-6	trans-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	79-01-6	Trichloroethene	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-69-4	Trichlorofluoromethane	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	75-01-4	Vinyl Chloride	10	UG/KG	UH	R
CAL0010801VG	3AY24RERE	ORG	(VOC)	1330-20-7	Xylene, Isomers m&p	20	UG/KG	UH	R

H3 Calcine SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	106-46-7	1,4-Dichlorobenzene	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	95-95-4	2,4,5-Trichlorophenol	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	88-06-2	2,4,6-Trichlorophenol	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	121-14-2	2,4-Dinitrotoluene	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	95-48-7	2-Methylphenol (o-Cresol)	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	*3&4-METHYLPHENOL	3&4-methylphenol	20	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	118-74-1	Hexachlorobenzene	20	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	87-68-3	Hexachlorobutadiene	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	67-72-1	Hexachloroethane	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	98-95-3	Nitrobenzene	10	UG/L	U	
CAL0010501TA	3AY21	ORG	(TCLP SVOC)	87-86-5	Pentachlorophenol	10	UG/L	U	

H3 Calcine Total SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	120-82-1	1,2,4-Trichlorobenzene	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	95-50-1	1,2-Dichlorobenzene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	541-73-1	1,3-Dichlorobenzene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	106-46-7	1,4-Dichlorobenzene	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	95-95-4	2,4,5-Trichlorophenol	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	88-06-2	2,4,6-Trichlorophenol	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	120-83-2	2,4-Dichlorophenol	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	105-67-9	2,4-Dimethylphenol	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	51-28-5	2,4-Dinitrophenol	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	121-14-2	2,4-Dinitrotoluene	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	606-20-2	2,6-Dinitrotoluene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	91-58-7	2-Chloronaphthalene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	95-57-8	2-Chlorophenol	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	91-57-6	2-Methylnaphthalene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	95-48-7	2-Methylphenol (o-Cresol)	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	88-74-4	2-Nitroaniline	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	88-75-5	2-Nitrophenol	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	*3&4-METHYLPHENOL	3&4-methylphenol	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	91-94-1	3,3'-Dichlorobenzidine	600	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	99-09-2	3-Nitroaniline	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	534-52-1	4,6-Dinitro-2-methylphenol	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	101-55-3	4-Bromophenyl phenyl ether	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	59-50-7	4-Chloro-3-methylphenol	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	106-47-8	4-Chloroaniline	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	7005-72-3	4-Chlorophenyl phenyl ether	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	100-01-6	4-Nitroaniline	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	100-02-7	4-Nitrophenol	400	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	83-32-9	Acenaphthene	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	208-96-8	Acenaphthylene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	120-12-7	Anthracene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	103-33-3	Azobenzene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	56-55-3	Benzo(a)anthracene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	50-32-8	Benzo(a)pyrene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	205-99-2	Benzo(b)fluoranthene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	191-24-2	Benzo(g,h,i)perylene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	207-08-9	Benzo(k)fluoranthene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	85-68-7	Benzyl butyl phthalate	600	UG/KG	U	R

CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	111-91-1	bis-(2-chloroethoxy)methane	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	111-44-4	Bis-(2-Chloroethyl)ether	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	108-60-1	bis(2-Chloroisopropyl)ether	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	117-81-7	bis-(2-ethylhexyl)phthalate	1000	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	86-74-8	Carbazole	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	218-01-9	Chrysene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	53-70-3	Dibenzo(a,h)anthracene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	132-64-9	Dibenzofuran	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	84-66-2	Diethyl Phthalate	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	131-11-3	Dimethyl phthalate	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	84-74-2	Di-n-butyl phthalate	800	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	117-84-0	Di-n-octyl phthalate	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	206-44-0	Fluoranthene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	86-73-7	Fluorene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	118-74-1	Hexachlorobenzene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	87-68-3	Hexachlorobutadiene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	77-47-4	Hexachlorocyclopentadiene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	67-72-1	Hexachloroethane	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	193-39-5	Indeno(1,2,3-cd)pyrene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	78-59-1	Isophorone	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	91-20-3	Naphthalene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	98-95-3	Nitrobenzene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	62-75-9	n-Nitrosodimethylamine	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	621-64-7	n-Nitrosodi-n-propylamine	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	86-30-6	n-Nitrosodiphenylamine	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	87-86-5	Pentachlorophenol	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	85-01-8	Phenanthrene	200	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	108-95-2	Phenol	200	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	129-00-0	Pyrene	400	UG/KG	UZ	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	110-86-1	Pyridine	400	UG/KG	U	R
CAL0010501SV	3AY21	ORG	(SEMIVOLATILE)	126-73-8	tri-n-butyl phosphate	200	UG/KG	U	R

Zr Calcine Metals Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Analyte	Result	Units	Concentration Qualifier	Lab Flag	Validation Flag
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7429-90-5	Aluminum	6.24E+04	UG/L			
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-36-0	Antimony	6.56E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-38-2	Arsenic	4.75E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-39-3	Barium	9.60E+02	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-41-7	Beryllium	2.02E+01	UG/L	U		UJ
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-43-9	Cadmium	7.07E+01	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-70-2	Calcium	9.00E+05	UG/L			
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-47-3	Chromium	6.93E+03	UG/L			
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-48-4	Cobalt	1.01E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-50-8	Copper	1.52E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-89-6	Iron	3.84E+02	UG/L	B		U
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-92-1	Lead	3.74E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-95-4	Magnesium	7.30E+04	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-96-5	Manganese	2.52E+02	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-97-6	Mercury	4.52E+02	UG/L			R
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7439-98-7	Molybdenum	4.04E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-02-0	Nickel	2.42E+02	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-09-7	Potassium	2.03E+04	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7782-49-2	Selenium	4.95E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-22-4	Silver	1.62E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-23-5	Sodium	1.30E+05	UG/L	B		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-28-0	Thallium	4.95E+02	UG/L	U		UJ
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-62-2	Vanadium	2.83E+02	UG/L	U		
CAL0012101TI	3AZ65	INORG	(TCLP METALS)	7440-66-6	Zinc	1.01E+03	UG/L	B		
CAL0012501TI	3AZ69	INORG	(TCLP METALS)	7429-90-5	Aluminum	4.11E+04	UG/L			
CAL0012501TI	3AZ69	INORG	(TCLP METALS)	7440-36-0	Antimony	6.56E+02	UG/L	U		
CAL0012501TI	3AZ69	INORG	(TCLP METALS)	7440-38-2	Arsenic	4.75E+02	UG/L	U		

Zr Calcine VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	71-43-2	Benzene	10	UG/L	UHZ	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	78-93-3	2-Butanone	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	56-23-5	Carbon tetrachloride	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	108-90-7	Chlorobenzene	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	67-66-3	Chloroform	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	75-35-4	1,1-Dichloroethene	10	UG/L	UHZ	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	107-06-2	1,2-Dichloroethane	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	127-18-4	Tetrachloroethene	10	UG/L	UH	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	79-01-6	Trichloroethene	10	UG/L	UHZ	R
CAL0012101TV	3AZ65	ORG	(TCLP VOC)	75-01-4	Vinyl Chloride	10	UG/L	UH	R

Zr Calcine Total VOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0012201VG	3AZ66	ORG	(VOC)	71-55-6	1,1,1-Trichloroethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	79-34-5	1,1,2,2-Tetrachloroethane	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	10	UG/KG	UHZ	R
CAL0012201VG	3AZ66	ORG	(VOC)	79-00-5	1,1,2-Trichloroethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-34-3	1,1-Dichloroethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-35-4	1,1-Dichloroethene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	107-06-2	1,2-Dichloroethane	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	78-87-5	1,2-Dichloropropane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	78-93-3	2-Butanone	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	591-78-6	2-Hexanone	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	108-10-1	4-Methyl-2-pentanone	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	67-64-1	Acetone	100	UG/KG	JBHEZ	U
CAL0012201VG	3AZ66	ORG	(VOC)	71-43-2	Benzene	20	UG/KG	UHZ	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-27-4	Bromodichloromethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-25-2	Bromoform	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	74-83-9	Bromomethane	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-15-0	Carbon disulfide	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	56-23-5	Carbon tetrachloride	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	108-90-7	Chlorobenzene	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-00-3	Chloroethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	67-66-3	Chloroform	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	74-87-3	Chloromethane	10	UG/KG	JBH	U
CAL0012201VG	3AZ66	ORG	(VOC)	156-59-2	cis-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	10061-01-5	cis-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	124-48-1	Dibromochloromethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	100-41-4	Ethylbenzene	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-09-2	Methylene Chloride	20	UG/KG	UHZ	R
CAL0012201VG	3AZ66	ORG	(VOC)	95-47-6	o-Xylene	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	100-42-5	Styrene	10	UG/KG	UMH	R
CAL0012201VG	3AZ66	ORG	(VOC)	127-18-4	Tetrachloroethene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	108-88-3	Toluene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	156-60-5	trans-1,2-Dichloroethene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	10061-02-6	trans-1,3-Dichloropropene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	79-01-6	Trichloroethene	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-69-4	Trichlorofluoromethane	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	75-01-4	Vinyl Chloride	10	UG/KG	UH	R
CAL0012201VG	3AZ66	ORG	(VOC)	1330-20-7	Xylene, Isomers m&p	20	UG/KG	UH	R

Zr Calcine SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	106-46-7	1,4-Dichlorobenzene	10	UG/L	UHZ	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	121-14-2	2,4-Dinitrotoluene	10	UG/L	UHZ	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	118-74-1	Hexachlorobenzene	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	87-68-3	Hexachlorobutadiene	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	67-72-1	Hexachloroethane	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	95-48-7	2-Methylphenol (o-Cresol)	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	*3&4-METHYLPHENOL	3&4-methylphenol	20	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	98-95-3	Nitrobenzene	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	87-86-5	Pentachlorophenol	10	UG/L	UHZ	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	95-95-4	2,4,5-Trichlorophenol	10	UG/L	UH	R
CAL0012101TA	3AZ65	ORG	(TCLP SVOC)	88-06-2	2,4,6-Trichlorophenol	10	UG/L	UH	R

Zr Calcine Total SVOC Representative Analytical Data

Field Sample ID	Lab Sample ID	Type	Analysis	CAS Number	Compound	Result	Units	Lab Flag	Validator Flag
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	83-32-9	Acenaphthene	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	208-96-8	Acenaphthylene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	120-12-7	Anthracene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	103-33-3	Azobenzene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	56-55-3	Benzo(a)anthracene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	205-99-2	Benzo(b)fluoranthene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	207-08-9	Benzo(k)fluoranthene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	191-24-2	Benzo(g,h,i)perylene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	50-32-8	Benzo(a)pyrene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	111-91-1	bis-(2-chloroethoxy)methane	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	111-44-4	bis-(2-Chloroethyl)ether	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	108-60-1	bis(2-Chloroisopropyl)ether	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	117-81-7	bis-(2-ethylhexyl)phthalate	1000	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	101-55-3	4-Bromophenyl phenyl ether	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	85-68-7	Benzyl butyl phthalate	600	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	86-74-8	Carbazole	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	106-47-8	4-Chloroaniline	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	59-50-7	4-Chloro-3-methylphenol	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	91-58-7	2-Chloronaphthalene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	95-57-8	2-Chlorophenol	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	7005-72-3	4-Chlorophenyl phenyl ether	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	218-01-9	Chrysene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	53-70-3	Dibenzo(a,h)anthracene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	132-64-9	Dibenzofuran	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	84-74-2	Di-n-butyl phthalate	800	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	95-50-1	1,2-Dichlorobenzene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	541-73-1	1,3-Dichlorobenzene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	106-46-7	1,4-Dichlorobenzene	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	91-94-1	3,3'-Dichlorobenzidine	600	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	120-83-2	2,4-Dichlorophenol	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	84-66-2	Diethyl Phthalate	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	105-67-9	2,4-Dimethylphenol	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	131-11-3	Dimethyl phthalate	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	534-52-1	4,6-Dinitro-2-methylphenol	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	51-28-5	2,4-Dinitrophenol	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	121-14-2	2,4-Dinitrotoluene	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	606-20-2	2,6-Dinitrotoluene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	117-84-0	Di-n-octyl phthalate	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	206-44-0	Fluoranthene	200	UG/KG	UH	UJ

CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	86-73-7	Fluorene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	118-74-1	Hexachlorobenzene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	87-68-3	Hexachlorobutadiene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	77-47-4	Hexachlorocyclopentadiene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	67-72-1	Hexachloroethane	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	193-39-5	Indeno(1,2,3-cd)pyrene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	78-59-1	Isophorone	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	91-57-6	2-Methylnaphthalene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	95-48-7	2-Methylphenol (o-Cresol)	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	*3&4-METHYLPHENOL	3&4-methylphenol	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	91-20-3	Naphthalene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	88-74-4	2-Nitroaniline	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	99-09-2	3-Nitroaniline	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	100-01-6	4-Nitroaniline	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	98-95-3	Nitrobenzene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	88-75-5	2-Nitrophenol	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	100-02-7	4-Nitrophenol	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	62-75-9	n-Nitrosodimethylamine	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	86-30-6	n-Nitrosodiphenylamine	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	621-64-7	n-Nitrosodi-n-propylamine	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	87-86-5	Pentachlorophenol	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	85-01-8	Phenanthrene	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	108-95-2	Phenol	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	129-00-0	Pyrene	400	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	110-86-1	Pyridine	400	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	126-73-8	tri-n-butyl phosphate	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	120-82-1	1,2,4-Trichlorobenzene	200	UG/KG	UHZ	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	95-95-4	2,4,5-Trichlorophenol	200	UG/KG	UH	UJ
CAL0012101SV	3AZ65RA	ORG	(SEMIVOLATILE)	88-06-2	2,4,6-Trichlorophenol	200	UG/KG	UH	UJ

Flags found in the analytical data tables for organics.

Flags	Represent	VOC	Total VOC	SVOC	Total SVOC
B	Analyte detected in blank		X		
D	Identified in an analysis at a secondary dilution factor	X			
E	Analyte exceeds the calibration curve		X		
H	Holding time exceeded	X	X	X	X
J	Estimated value		X		X
M	Indicates that the analyte was quantified using a calibration curve constructed using a first or higher order regression fit	X	X		
R	The data are unusable (may or may not be present). Resampling and reanalysis is necessary for verification	X	X	X	X
U	Analyte was not detected (report sample-specific MDL)	X	X	X	X
Z	One or more QC samples do not meet acceptance criteria	X	X	X	X

Flags found in the analytical data tables for metals.

Flags	Represent	Metals	Total Metals
B	Reported value is less than contract required detection limit, but greater than or equal to IDL	X	X
D	Identified in an analysis at a secondary dilution factor	X	X
J	Estimated value	X	X
N	Spiked sample recovery was not within control limits	X	X
R	The data are unusable (may or may not be present). Resampling and reanalysis is necessary for verification	X	
U	Analyte was not detected (report sample-specific IDL)	X	X

Appendix 4
CSSF Engineering
Design File

RCRA PART B PERMIT REAPPLICATION

FOR THE
IDAHO NATIONAL LABORATORY

VOLUME 22
IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

APPENDIX 4

CSSF ENGINEERING DESIGN FILE

May 2016

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Engineering Design File

Hydrostatic and Hydrodynamic Forces on the INTEC CSSF During a 100-Year Flood

Prepared for:
U.S. Department of Energy
Idaho Operations Office
Idaho Falls, Idaho

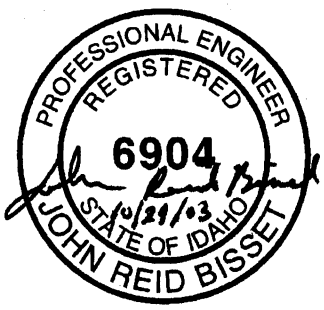


Idaho National Engineering
and Environmental Laboratory

Form 412.14
07/24/2001
Rev. 03

PEER REVIEW OF EDF-3996

The peer review of revision 0 of EDF-3996, "Hydrostatic and Hydrodynamic Forces on the INTEC CSSF During a 100-Year Flood," indicates that the analysis performed in this EDF meets the appropriate criteria for evaluating partially underground structures. Soil pressures based on an actual geotechnical investigation and well established soil mechanics theory were used. Also, appropriate hydrostatic pressures were applied based on an actual flooding evaluation. Load Factors of 1.00 were used, which are appropriate for evaluations to meet RCRA requirements. The analyses in EDF-3996 indicate that the imposed moments, the critical reactions, are within the ACI 318 code allowable values. The EDF therefore provides adequate assurance that the reinforced vault structures will not fail during the 100-year flood referenced in the EDF.



ENGINEERING DESIGN FILE

EDF No.: 3996 EDF Rev. No.: 0 Project File No.:

1. Title: Hydrostatic and Hydrodynamic Forces on the INTEC CSSF During a 100-Year Flood

2. Index Codes:
   Building/Type Various SSC ID Calcined Solids Storage Facility (Bin Sets) Site Area 200

3. NPH Performance Category: _____ or ☒ N/A

4. EDF Safety Category: SS or ☐ N/A SCC Safety Category: SS or ☐ N/A

5. Summary:

The purpose of this analysis is to evaluate the INTEC Calcined Solids Storage Facility (Bin Sets) to determine if the facility can withstand floodwater forces during a 100-year flood at the INEEL site. This analysis is performed to ensure compliance with RCRA regulations that require an engineering analysis to determine the various hydrodynamic and hydrostatic forces expected to result at the site as a consequence of a 100-year flood. The design basis flood event is a 100-year flood coincident with a Mackay Dam failure. The floodwater elevation for the postulated flood is 4916 ft and the floodwater depth at INTEC is approximately 4 ft.

The Calcined Solids Storage Facility includes seven bin sets, with each set consisting of 3 to 7 stainless steel storage bins located in concrete vaults that are partially or completely underground. A structural evaluation of the vaults was used to check whether the vault walls have enough strength to withstand hydrodynamic and hydrostatic forces resulting from the postulated 100-year flood. The concrete walls of bin sets 1 to 7 meet the structural requirements given in ACI-318. The structural capacity of the walls ensures that washout of hazardous waste from these bin sets will be prevented.

6. Review (R) and Approval (A) and Acceptance (Ac) Signatures:

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12. NRC related? ☐ Yes ☒ No

13. Registered Professional Engineer's Stamp (See attached letter.)

Purpose

The purpose of this analysis is to evaluate the INTEC Calcined Solids Storage Facility (Bin Sets) to determine if the facility can withstand floodwater forces during a 100-year flood at the INEEL site. This analysis is performed to ensure compliance with RCRA regulations [1] that require an engineering analysis to determine the various hydrodynamic and hydrostatic forces expected to result at the site as a consequence of a 100-year flood, and structural or other engineering studies showing the design of operational units and flood protection devices at the facility and how these will prevent washout. In the RCRA regulations, washout is defined as the movement of hazardous waste from the active portion of a facility as a result of flooding.

Scope

The Calcined Solids Storage Facility includes seven bin sets, with each set consisting of 3 to 7 stainless steel storage bins located in concrete vaults that are partially or completely underground. A structural evaluation of the concrete vaults is needed to check whether the walls have enough strength to resist damage as a result of hydrodynamic and hydrostatic forces that may occur during a 100-year flood coincident with a Mackay Dam failure.

Safety Category

Safety categories are used for systems, structures, and components (SSC) to establish a graded approach to design and analysis based on the safety function performed by the SSC. The bin sets have been identified as Safety Significant per SAR-104 [8] and SAR-106 [9].

Natural Phenomena Hazards Performance Category

Performance categories are used for an SSC exposed to natural phenomena hazards to establish a graded approach to design and analysis based on the importance of the SSC. The bin sets have been identified as PC-2 per SAR-104 [8] and SAR-106 [9]. However, the performance category is not used in this analysis since the design basis flood event and scope of the analysis are governed by RCRA regulations.

Subject Specific Data

Koslow and Van Haaften [2] examined the consequences of a failure of Mackay Dam and performed a hydraulic analysis to determine the extent of the flood plain for several scenarios. Their analysis included a 100-year flood and simultaneous piping failure at Mackay Dam, which leads to a breach of the dam, overtopping of the INEEL diversion dam, and flooding of the INEEL site. This scenario results in a peak flow released from the dam equal to 57,740 ft^3/s. The flow between Mackay Dam and the INEEL is attenuated by storage, agricultural diversion, and channel infiltration. The calculated flow at the INEEL diversion dam is 28,500 ft^3/s. Since the diversion dam is unable to retain the high flow, most of the floodwater will flow onto the site.

The peak flow calculated by Koslow and Van Haaften [2] was used in a flow routing analysis to determine the extent of the flood plain at the INEEL site. A hydraulic analysis of open channel flow was used to compute the peak flow and water elevation at each cross-section of the Big Lost River channel. The leading edge of the flood wave arrives at INTEC approximately 17.1 hours after breach of the dam. The peak flow is attenuated to 24,870 ft^3/s, and the peak water velocity is 2.2 ft/s. Since the area surrounding INTEC is very flat, floodwater will spread easily and so the flood plain is wide and shallow. The elevation of the streambed in the vicinity of INTEC is 4911 ft. and the calculated water elevation is 4916 ft.

Koslow and Van Haaften [2] also performed an analysis to examine the potential for overland flooding due to localized heavy rain and snowmelt. It was found that localized flooding due to a 25-year peak rainfall and simultaneous snowmelt lead to a peak flow of 32 ft^3/s. Although this

runoff can be accommodated by the drainage basin at INTEC and flood control devices such as culverts, dikes, and ditches, floodwater may collect in low-elevation areas.

With the exception of bin set 1, the structural design of the bin sets is similar. Stainless steel bins are arranged inside a cylindrical vault constructed of reinforced concrete. Bin set 1 is contained inside a rectangular concrete vault. The vault for bin set 1 is completely underground and the vaults for bin sets 2 through 7 are partially underground. A soil embankment surrounds the vaults for bin sets 2 and 3. Regarding the 100-year flood, the main concern is whether the external structure is strong enough to withstand hydrostatic and hydrodynamic forces, or whether the structure will be damaged and allow hazardous waste to escape. It is sufficient to show that the concrete walls can withstand floodwater forces, which include soil pressure, static water pressure, and dynamic wave pressure.

The elevations of the concrete base slabs of each bin set, as shown on the construction drawings, are listed in Table 1. Elevations are currently measured in reference to the National Geodetic Vertical Datum of 1929 (NGVD29). However, the bin sets were constructed during the years 1959 to 1985, when the datum was not NGVD29. Elevations in reference to NGVD29 are approximately 1 ft. less than those shown on the construction drawings. This correction is included in Table 1.

Table 1. Base slab elevations in feet above sea level.

Bin Set	Elevation at top of base slab (shown on as-built drawing)	Elevation at top of base slab (in reference to NGVD29)	INEEL Drawing Number
1 (CPP-729)	4869.0	4868.0	106583
2 (CPP-742)	4872.0	4871.0	118876
3 (CPP-746)	4866.5	4865.5	153241
4 (CPP-760)	4868.0	4867.0	157778
5 (CPP-765)	4868.0	4867.0	158457
6 (CPP-791)	4868.5	4867.5	161360
7 (CPP-795)	4868.5	4867.5	168109

1. WCF Bin Sets 1 – 3 were built from 1959 to 1969 and NWCF Bin Sets 4 – 7 were built from 1976 to 1985.

Assumptions

1. The only pathway for floodwater infiltration into a bin set vault is at pipe penetrations, which are sealed and watertight.
2. The floodwater elevation for the postulated 100-year flood coincident with a Mackay Dam failure is 4916 ft. in reference to NGVD29 (Koslow and Van Haaften, [2]). Since the elevation at grade level is approximately 4912 ft., the floodwater depth is 4 ft.
3. The wave height of shallow water waves generated by a 60 mph wind with a water depth equal to 4 ft is approximately 2 ft from crest to trough (Fig. 10-16 in Brater and King [3]). The maximum water level during the postulated 100-year flood is 4917 ft. (still water level + ½ wave height).

Acceptance Criteria

The concrete walls of the bin sets shall meet the structural requirements given in ACI-318 [4].

Software

All calculations use equations for stress given in Roark and Young [5] and Szilard [11]. MathCAD was used to evaluate the mathematical equations, which were independently verified by hand calculation.

Calculations

The data used in the calculations is given in Tables 2 - 4. This data includes vault height, vault diameter, wall thickness, depth of surrounding soil (elevation at grade – elevation of base slab), details of the vertical reinforcing bar, and details of the dowels joining the wall and base slab.

Table 2. Structural details of bin set vaults – dimensions.

Bin Set	Vault Inside Diameter (ft)	Vault Wall Height (ft)	Vault Wall Thickness (ft)	Soil Depth at Base Slab (ft)	INEEL Drawing Number
1 (CPP-729)	25.5[1]	41.3	2.5	52.8	106583, 106585
2 (CPP-742)	46	61.8	2	67.3	118877, 118879
3 (CPP-746)	46	67.2	2	72.8	153242, 154148
4 (CPP-760)	36	64.7	2[2]	45.5	157774, 157778
5 (CPP-765)	47	73.2	4	45.3	158457, 158462
6 (CPP-791)	52.3	88.5	4.25	44.5	161360, 161373
7 (CPP-795)	52.3	88.5	4.25	44.5	168109, 168110, 168116

1. Vault is rectangular; dimension indicates width of inside wall.
2. Wall thickness varies from 2 ft. at bottom to 3.5 ft. at top.

Table 3. Structural details of bin set vaults – vertical reinforcing bar.

Bin Set	Vertical reinforcing bar (outside face)	Vertical reinforcing bar (inside face)	INEEL Drawing Number
1 (CPP-729)	#5@ 14 in.	#5@ 14 in.	106583, 106585, 106588
2 (CPP-742)	#10@ 8 in. or #11@ 10 in.	#6@ 18 in.	118877
3 (CPP-746)	#11@ 10 in.	#6@ 18 in.	153242
4 (CPP-760)	#11@ 6 in.	#6@ 12 in.	157778
5 (CPP-765)	#11@ 6 in.	#9@ 12 in.	158468
6 (CPP-791)	#14@ 6 in.	#14@ 6 in.	161377
7 (CPP-795)	#11@ 6 in.	#11@ 6 in.	168120

1. Rebar strength varies; 40,000 psi for Bin Sets 1 – 3 is assumed and 60,000 psi for Bin Sets 4 – 7 per ASTM A432.
2. Concrete compressive strength varies; 3000 psi for Bin Set 1 and 4000 psi for Bin Sets 2 –7 is assumed.
3. Concrete cover varies; 2 in. for wall thickness of 2 ft. and 5 in. for wall thickness of 4 ft. is assumed.

Table 4. Structural details of bin set vaults – dowels joining wall and base slab.

Bin Set	Dowels (outside face)	Dowels (inside face)	INEEL Drawing Number
1 (CPP-729)	#9@ 14 in.	#9@ 14 in.	106583, 106585, 106588
2 (CPP-742)	#9@ 2°	#9@ 2°	118876
3 (CPP-746)	#9@ 2°	#9@ 2°	153241
4 (CPP-760)	#11@ 6 in.	#6@ 12 in.	157777
5 (CPP-765)	#11@ 6 in.	#9@ 12 in.	158467
6 (CPP-791)	#14@ 6 in.	#14@ 6 in.	161377
7 (CPP-795)	#11@ 6 in.	#11@ 6 in.	168120

1. Rebar strength varies; 40,000 psi for Bin Sets 1 – 3 is assumed and 60,000 psi for Bin Sets 4 – 7 per ASTM A432.

The data given in the tables above was used to calculate the bending moment and shear in the wall of each bin set vault. In the case of bin sets 2 – 7, the wall was modeled as a hollow cylinder with the bottom end fixed to the base slab and the top end free to move. In the case of bin set 1, the wall was modeled as a plate with the bottom and sides fixed to the base slab and adjoining walls and the top pinned to the roof slab. External pressure boundary conditions were applied to the outer surface of the cylinder and plate, which represent hydrostatic and hydrodynamic forces. Soil properties were obtained from references [6] and [7]. The bending moment and shear were compared to the moment and shear capacity of the concrete wall. Since a 100-year flood with a Mackay Dam failure is the maximum credible flood associated with a 100-year peak flow in the Big Lost River (exceeding RCRA requirements for a design basis flood event), load factors for floodwater forces and soil pressure were set equal to one. The calculations for each bin set are given in Appendices A – G.

Conclusions

A structural evaluation of the bin set vaults was used to check whether the vault walls are able to withstand hydrostatic and hydrodynamic forces resulting from the postulated 100-year flood. The concrete walls of bin sets 1 to 7 meet the structural requirements given in ACI-318 [4]. The structural capacity of the walls ensures that washout of hazardous waste from these bin sets will be prevented.

References

1. *Code of Federal Regulations*, 40 CFR Sect. 270.14(b) Para. 11(iv), August 1, 2000.
2. K. N. Koslow and D. H. Van Haaften, *Flood Routing Analysis for a Failure of Mackay Dam*, EGG-EP-7184, June, 1986.
3. E. F. Brater and H. W. King, *Handbook of Hydraulics*, 6th Edition, McGraw-Hill, NY, 1976.
4. *Building Code Requirements for Structural Concrete*, ACI 318-99, American Concrete Institute, 1999.
5. R. J. Roark and W. C. Young, *Formulas for Stress and Strain*, 5th Edition, McGraw-Hill, NY, 1975.
6. *Soil and Foundation Investigation for the Proposed New Waste Calcining Facility*, Prepared for The Energy Research and Development Administration, Fluor Contract No. 453504, Dames and Moore, 1976.
7. R. B. Peck, W. E. Hanson, and T. H. Thornburn, *Foundation Engineering*, 2nd Edition, John Wiley & Sons, NY, 1974.
8. *Safety Analysis Report – First Calcined Solids Storage Facility*, SAR-104, July 2001.
9. *Safety Analysis Report – Sixth Calcined Solids Storage Facility*, SAR-106, January 2002.
10. *Deformed Billet Steel Bars for Concrete Reinforcement With 60,000 PSI Minimum Yield Strength*, ASTM A432-64, American Society for Testing and Materials, 1964.
11. R. Szilard, *Theory and Analysis of Plates*, Prentice-Hall, Englewood Cliffs, NJ, 1974.

Appendices

A. Concrete Stress Calculations for Bin Set 1.
B. Concrete Stress Calculations for Bin Set 2.
C. Concrete Stress Calculations for Bin Set 3.
D. Concrete Stress Calculations for Bin Set 4.
E. Concrete Stress Calculations for Bin Set 5.
F. Concrete Stress Calculations for Bin Set 6.
G. Concrete Stress Calculations for Bin Set 7.

Calculate bending moment and shear in the vault wall. Wall is modeled as a rectangular plate loaded by external pressure. Plate is fixed at the base, fixed at the sides and simply supported at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and bending.

$D := 25.5 \cdot ft$ Width of plate.

$H := 41.3 \cdot ft$ Height of plate.

$t := 2.5 \cdot ft$ Wall thickness.

$d_{soil} := 52.8 \cdot ft$ Depth of soil at base of plate.

$d_{water} := 48.0 \cdot ft$ Depth of water at base of plate.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil, from Table I in "Soil and Foundation Investigation for the Proposed New Waste Calcining Facility."

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil, from Table 1.4 in Peck, Hanson, and Thornburn, "Foundation Engineering."

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction, from Table I in "Soil and Foundation Investigation for the Proposed New Waste Calcining Facility."

$\phi = 0.75$

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$K_0 = 0.318$

$f_c := 3000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.321 \times 10^6 psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 26, Case 9a.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.219 \times 10^3 \frac{lbf}{ft^2}$

$r := \frac{D}{H}$ $r = 0.617$ Ratio of width to height.

Interpolate to get required solution parameters.

$\beta_{11} := 0.081$ $\beta_{21} := 0.018$ $\gamma_{11} := 0.230$ Solution parameters for r=0.50.

$\beta_{12} := 0.173$ $\beta_{22} := 0.062$ $\gamma_{12} := 0.343$ Solution parameters for r=0.75.

$\beta_1 := \beta_{11} + (\beta_{12} - \beta_{11}) \cdot \frac{r - 0.5}{0.25}$ $\beta_1 = 0.124$

$\gamma_1 := \gamma_{11} + (\gamma_{12} - \gamma_{11}) \cdot \frac{r - 0.5}{0.25}$ $\gamma_1 = 0.283$

$\beta_2 := \beta_{21} + (\beta_{22} - \beta_{21}) \cdot \frac{r - 0.5}{0.25}$ $\beta_2 = 0.039$

$R_1 := \gamma_1 \cdot w \cdot H$ Reaction at center of fixed base. $R_1 = 1.425 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{-\beta_1 \cdot w \cdot H^2}{6}$ Moment at center of fixed base. $M_1 = -4.305 \times 10^4 \frac{lbf \cdot ft}{ft}$

Solution from Roark and Young is given in terms of bending stress. Bending moment is obtained from relation between moment and bending stress for a rectangular section: $\sigma = 6\ M / t^2$.

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and shear at center of fixed base.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 1.425 \times 10^4 \frac{lbf}{ft}$ $M_{neg_soil} = -4.305 \times 10^4 \frac{lbf \cdot ft}{ft}$

Positive moment at a distance of 0.6 H from center of fixed base

$M_1 := \frac{\beta_2 \cdot w \cdot H^2}{6}$ Moment at a distance of 0.6 H from center of fixed base. $M_1 = 1.34 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_1$ Positive moment. $M_{pos_soil} = 1.34 \times 10^4 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 2.995 \times 10^3 \frac{lbf}{ft^2}$

Note: "w" redefined for this load case.

$R_1 := \gamma_1 \cdot w \cdot H$ Reaction at center of fixed base. $R_1 = 3.502 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{-\beta_1 \cdot w \cdot H^2}{6}$ Moment at center of fixed base. $M_1 = -1.058 \times 10^5 \frac{lbf \cdot ft}{ft}$

Solution from Roark and Young is given in terms of bending stress. Bending moment is obtained from relation between moment and bending stress for a rectangular section: $\sigma = 6\ M / t^2$.

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and shear at center of fixed base.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 3.502 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -1.058 \times 10^5 \frac{lbf \cdot ft}{ft}$

Positive moment at a distance of 0.6 H from center of fixed base.

$M_1 := \frac{\beta_2 \cdot w \cdot H^2}{6}$ Moment at a distance of 0.6 H from center of fixed base. $M_1 = 3.293 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_1$ Positive moment. $M_{pos_water} = 3.293 \times 10^4 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 4.927 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -1.488 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 4.633 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 40000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.128 \cdot in$ Diameter of #9 rebar.

$A_s := 1.0 \cdot in^2$ Cross-sectional area of #9 rebar.

$s := 14 \cdot in$ Spacing of dowels at inside and outside faces.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.857\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 5.829 \times 10^4\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 4.927 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.845$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 2 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 0.625 \cdot in$ Diameter of #5 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.31 \cdot in^2$ Cross-sectional area of #5 rebar.

$s := 14 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.266\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 2.193 \times 10^4\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 1.488 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 6.785$ Not OK.

Check rebar at inside face.

$d_s := 0.625 \cdot in$ Diameter of #5 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.31 \cdot in^2$ Cross-sectional area of #5 rebar.

$s := 14 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.266\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 2.193 \times 10^4\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 4.633 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 2.112$ Not OK.

Vertical bar is unable to resist bending moment. Redo calculations with base simply supported instead of fixed and assuming horizontal bar carries entire load.

Use solution given in Szilard, "Theory and Analysis of Plates," Case 90, p. 661. Bending moment with hydrostatic loading is C_i w b^2, with w = load, b = width of plate, and C_i a coefficient given below for moment about vertical axis and height to width ratio of plate equal to 2.

$C_1 := -0.0572$ For maximum negative moment near base and edge of plate.

$C_2 := -0.0424$ For negative moment at midpoint of edge of plate.

$C_5 := 0.0247$ For maximum positive moment near base and center of plate.

$C_6 := 0.0207$ For positive moment at center of plate.

$h := 52.8 \cdot ft$ Plate height (from top of base slab to top of roof).

$b := 25.5 \cdot ft$ Plate width.

$r := \frac{h}{b}$ $r = 2.071$ Ratio of height to width.

Load 1: Hydrostatic load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ $w = 1.219 \times 10^3 \frac{lbf}{ft^2}$

Note: "w" redefined for new load cases.

Bending moments:

$M_{1_soil} := C_1 \cdot w \cdot D^2$ $M_{1_soil} = -4.534 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{2_soil} := C_2 \cdot w \cdot D^2$ $M_{2_soil} = -3.361 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{5_soil} := C_5 \cdot w \cdot D^2$ $M_{5_soil} = 1.958 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{6_soil} := C_6 \cdot w \cdot D^2$ $M_{6_soil} = 1.641 \times 10^4 \frac{lbf \cdot ft}{ft}$

Reaction at boundary supports:

$R_{soil} := 0.5 \cdot w \cdot b$ $R_{soil} = 1.554 \times 10^4 \frac{lbf}{ft}$

Note: R and M are given per unit height of wall. M>0 when producing compression at outside face.

Load 2: Hydrostatic load due to water pressure.

$w := \gamma_w \cdot d_{water}$ $\quad w = 2.995 \times 10^3 \frac{lbf}{ft^2}$

Bending moments:

$M_{1_water} := C_1 \cdot w \cdot D^2$ $\quad M_{1_water} = -1.114 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_{2_water} := C_2 \cdot w \cdot D^2$ $\quad M_{2_water} = -8.258 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{5_water} := C_5 \cdot w \cdot D^2$ $\quad M_{5_water} = 4.811 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{6_water} := C_6 \cdot w \cdot D^2$ $\quad M_{6_water} = 4.032 \times 10^4 \frac{lbf \cdot ft}{ft}$

Reaction at boundary supports:

$R_{water} := 0.5 \cdot w \cdot b$ $\quad R_{water} = 3.819 \times 10^4 \frac{lbf}{ft}$

Note: R and M are given per unit height of wall. M>0 when producing compression at outside face.

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot R_{soil} + R_{water}$ $\quad V = 5.373 \times 10^4 \frac{lbf}{ft}$

$M_1 := 1.0 \cdot M_{1_soil} + M_{1_water}$ $\quad M_1 = -1.567 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_2 := 1.0 \cdot M_{2_soil} + M_{2_water}$ $\quad M_2 = -1.162 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_5 := 1.0 \cdot M_{5_soil} + M_{5_water}$ $\quad M_5 = 6.768 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_6 := 1.0 \cdot M_{6_soil} + M_{6_water}$ $\quad M_6 = 5.672 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1. Assume corner dowels carry entire load. Horizontal rebar specifications obtained from Drawing 106585

$f_y := 40000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.000 \cdot in$ Diameter of #8 rebar (dowels at top of wall).

$A_s := 0.79 \cdot in^2$ Cross-sectional area of #8 rebar.

$s := 9 \cdot in$ Spacing of dowels at both corners.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1.053\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot height of wall.

$V_c = 7.163 \times 10^4\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 5.373 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.75$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7. Assume horizontal rebar carries entire load.

$c := 2 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of section of wall.

Check 1: Rebar at outside face at midpoint of wall.

$d_s := 1.270 \cdot in$ Diameter of #10 rebar (corner strip rebar).

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.27 \cdot in^2$ Cross-sectional area of #10 rebar.

$s := 9 \cdot in$ Spacing of horizontal rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1.693\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot height of wall.

$M_c = 1.334 \times 10^5\,lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_2$ Factored moment. $M_u = 1.162 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.871$ OK.

Check 2: Rebar at outside face at base of wall.

$d_s := 1.410 \cdot in$ Diameter of #11 rebar (corner strip rebar).

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 9 \cdot in$ Spacing of horizontal rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 2.08\, in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot height of wall.

$M_c = 1.618 \times 10^5\, lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_1$ Factored moment. $M_u = 1.567 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.969$ OK.

Check 3: Rebar at inside face at midpoint of wall.

$d_s := 0.875 \cdot in$ Diameter of #7 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.60 \cdot in^2$ Cross-sectional area of #7 rebar.

$s := 9 \cdot in$ Spacing of horizontal rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.8\, in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot height of wall.

$M_c = 6.49 \times 10^4 \text{ lbf} \cdot \text{ft}$

Compare factored moment to moment capacity.

$M_u := M_6$ Factored moment. $M_u = 5.672 \times 10^4 \frac{\text{lbf} \cdot \text{ft}}{\text{ft}}$

$\text{ratio} := \frac{M_u \cdot 1 \cdot \text{ft}}{M_c}$ $\text{ratio} = 0.874$ OK.

Check 4: Rebar at inside face at base of wall.

$d_s := 1.000 \cdot \text{in}$ Diameter of #8 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.79 \cdot \text{in}^2$ Cross-sectional area of #8 rebar.

$s := 9 \cdot \text{in}$ Spacing of horizontal rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot \text{in}}{s}$ $A_s = 1.053 \text{ in}^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot height of wall.

$M_c = 8.472 \times 10^4 \text{ lbf} \cdot \text{ft}$

Compare factored moment to moment capacity.

$M_u := M_5$ Factored moment. $M_u = 6.768 \times 10^4 \frac{\text{lbf} \cdot \text{ft}}{\text{ft}}$

$\text{ratio} := \frac{M_u \cdot 1 \cdot \text{ft}}{M_c}$ $\text{ratio} = 0.799$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 46 \cdot ft$ Inside diameter of cylinder.

$H := 61.8 \cdot ft$ Height of cylinder.

$t := 2 \cdot ft$ Wall thickness.

$d_{soil} := 67.3 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 45.0 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters, see Roark and Young, Table 30, and discussion on p. 456.

$L := \lambda \cdot H$ $L = 11.62$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.554 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := H$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 8.263 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -2.197 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 8.263 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -2.197 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 4.567 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 4.567 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 2.808 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 1.494 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -3.971 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.
Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 1.494 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -3.971 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 8.266 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 8.266 \times 10^3 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $\quad V = 2.32 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $\quad M_{neg} = -6.168 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $\quad M_{pos} = 1.283 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 40000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.128 \cdot in$ Diameter of #9 rebar.

$A_s := 1.0 \cdot in^2$ Cross-sectional area of #9 rebar.

$s := \frac{C}{180}$ Spacing of dowels at inside and outside faces.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $\quad A_s = 1.146\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 7.792 \times 10^4\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $\quad V_u = 2.32 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $\quad ratio = 0.298$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 2 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 10 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1.872\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 1.144 \times 10^5\,lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 6.168 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.539$ OK.

Check rebar at inside face.

$d_s := 0.75 \cdot in$ Diameter of #6 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.44 \cdot in^2$ Cross-sectional area of #6 rebar.

$s := 18 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.293\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 1.89 \times 10^4\,lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 1.283 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.679$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 46 \cdot ft$ Inside diameter of cylinder.

$H := 67.2 \cdot ft$ Height of cylinder.

$t := 2 \cdot ft$ Wall thickness.

$d_{soil} := 72.8 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 50.5 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 \, psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters.

$L := \lambda \cdot H$ $L = 12.636$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.681 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := H$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 8.939 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -2.377 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 8.939 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -2.377 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 4.941 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 4.941 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 3.151 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 1.676 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -4.457 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 1.676 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -4.457 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 9.272 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 9.272 \times 10^3 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 2.57 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -6.834 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 1.421 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 40000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.128 \cdot in$ Diameter of #9 rebar.

$A_s := 1.0 \cdot in^2$ Cross-sectional area of #9 rebar.

$s := \frac{C}{180}$ Spacing of dowels at inside and outside faces.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1.146 in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 7.792 \times 10^4 lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 2.57 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.33$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 2 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 10 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1.872\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 1.144 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 6.834 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.597$ OK.

Check rebar at inside face.

$d_s := 0.75 \cdot in$ Diameter of #6 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.44 \cdot in^2$ Cross-sectional area of #6 rebar.

$s := 18 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.293\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 1.89 \times 10^4\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 1.421 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.752$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 36 \cdot ft$ Inside diameter of cylinder.

$H := 64.7 \cdot ft$ Height of cylinder.

$t := 2 \cdot ft$ Wall thickness.

$d_{soil} := 45.5 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 49 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters.

$L := \lambda \cdot H$ $L = 13.673$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.05 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{soil}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 4.971 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -1.176 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 4.971 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -1.176 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 2.358 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 2.358 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 3.058 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 1.447 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -3.423 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 1.447 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -3.423 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 6.86 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 6.86 \times 10^3 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 1.944 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -4.6 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 9.218 \times 10^3 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 60000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of dowels at outside face (#6 bar at inside face neglected).

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 1.591 \times 10^5\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 1.944 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.122$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 2 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 2.668 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 4.6 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.172$ OK.

Check rebar at inside face.

$d_s := 0.75 \cdot in$ Diameter of #6 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 0.44 \cdot in^2$ Cross-sectional area of #6 rebar.

$s := 12 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 0.44\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 4.218 \times 10^4\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 9.218 \times 10^3 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.219$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 47 \cdot ft$ Inside diameter of cylinder.

$H := 73.2 \cdot ft$ Height of cylinder.

$t := 4 \cdot ft$ Wall thickness.

$d_{soil} := 45.3 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 49 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 \, psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters.

$L := \lambda \cdot H$ $L = 9.442$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure.
Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.046 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{soil}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 8.087 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -3.139 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 8.087 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -3.139 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 4.281 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 4.281 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 3.058 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 2.366 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -9.172 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.
Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 2.366 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -9.172 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 1.271 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 1.271 \times 10^4 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 3.175 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -1.231 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 1.699 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 60000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of dowels at outside face (#9 bar at inside face neglected).

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 1.591 \times 10^5\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 3.175 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.2$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 5 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 5.616 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 1.231 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.219$ OK.

Check rebar at inside face.

$d_s := 1.128 \cdot in$ Diameter of #9 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.0 \cdot in^2$ Cross-sectional area of #9 rebar.

$s := 12 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 1\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 1.877 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 1.699 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.091$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 52.3 \cdot ft$ Inside diameter of cylinder.

$H := 88.5 \cdot ft$ Height of cylinder.

$t := 4.25 \cdot ft$ Wall thickness.

$d_{soil} := 44.5 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 48.5 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters.

$L := \lambda \cdot H$ $L = 10.517$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.027 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{soil}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 8.621 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -3.643 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 8.621 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -3.643 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 3.766 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 3.766 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 3.026 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 2.54 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -1.07 \times 10^5 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.
Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 2.54 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -1.07 \times 10^5 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 1.134 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 1.134 \times 10^4 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 3.402 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -1.435 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 1.51 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 60000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.693 \cdot in$ Diameter of #14 rebar.

$A_s := 2.25 \cdot in^2$ Cross-sectional area of #14 rebar.

$s := 6 \cdot in$ Spacing of dowels at inside and outside faces.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 4.5\ in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 4.59 \times 10^5\ lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 3.402 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.074$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 5 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.693 \cdot in$ Diameter of #14 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 2.25 \cdot in^2$ Cross-sectional area of #14 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 4.5\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 8.474 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 1.435 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.169$ OK.

Check rebar at inside face.

$d_s := 1.693 \cdot in$ Diameter of #14 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 2.25 \cdot in^2$ Cross-sectional area of #14 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 4.5\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 8.474 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 1.51 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.018$ OK.

Calculate bending moment and shear in the vault wall. Wall is modeled as a hollow cylinder loaded by external radial pressure. Cylinder is fixed at the base and free at the top. Load is hydrostatic pressure due to soil and water. Neglect weight of vault wall and loads due to weight of roof and equipment room since these loads cause compression rather than shear and

$D_i := 52.3 \cdot ft$ Inside diameter of cylinder.

$H := 88.5 \cdot ft$ Height of cylinder.

$t := 4.25 \cdot ft$ Wall thickness.

$d_{soil} := 44.5 \cdot ft$ Depth of soil at base of cylinder.

$d_{water} := 48.5 \cdot ft$ Depth of water at base of cylinder.

$\gamma_{dry} := 118 \cdot \frac{lbf}{ft^3}$ Weight of dry soil.

$\gamma_{wet} := 135 \cdot \frac{lbf}{ft^3}$ Weight of saturated soil.

$\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$ Weight of water.

$\phi := 43 \cdot \frac{\pi}{180}$ Angle of internal friction.

$K_0 := 1 - \sin(\phi)$ Earth pressure coefficient.

$f_c := 4000 \cdot psi$ Compressive strength of concrete.

$\gamma_c := 150 \cdot \frac{lbf}{ft^3}$ Weight of concrete.

$E_c := \gamma_c^{1.5} \cdot 33 \cdot \sqrt{f_c} \cdot \frac{ft^{4.5}}{lbf \cdot in}$ Modulus of elasticity of concrete.

$E_c = 3.834 \times 10^6 psi$

$\nu_c := 0.2$ Poisson's ratio of concrete.

Elasticity solution from Roark and Young, Table 8, Case 2, left end fixed.

$R := \frac{D_i + t}{2}$ Mean radius of cylinder.

$C := \pi \cdot (D_i + 2 \cdot t)$ Circumference of cylinder.

$\lambda := \left[\frac{3 \cdot (1 - \nu_c^2)}{R^2 \cdot t^2} \right]^{0.25}$ $D := \frac{E_c \cdot t^3}{12(1 - \nu_c^2)}$ Shell parameters.

$L := \lambda \cdot H$ $L = 10.517$ L>6 and resultant load closer to left end; use semi-infinite beam.

Total load is superposition of loads due to soil pressure and water pressure. Use a uniformly distributed load as a conservative approximation to a hydrostatic load.

Load 1: Uniformly distributed load due to soil pressure.

$w := K_0 \cdot (\gamma_{wet} - \gamma_w) \cdot d_{soil}$ Load. $w = 1.027 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{soil}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 8.621 \times 10^3 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -3.643 \times 10^4 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.

Maximum negative moment and maximum shear occur at fixed end.

$V_{soil} := R_1$ $M_{neg_soil} := M_1$ $V_{soil} = 8.621 \times 10^3 \frac{lbf}{ft}$ $M_{neg_soil} = -3.643 \times 10^4 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 3.766 \times 10^3 \frac{lbf \cdot ft}{ft}$

$M_{pos_soil} := M_{1A}$ Maximum positive moment. $M_{pos_soil} = 3.766 \times 10^3 \frac{lbf \cdot ft}{ft}$

Load 2: Uniformly distributed load due to water pressure.

$w := \gamma_w \cdot d_{water}$ Load. $w = 3.026 \times 10^3 \frac{lbf}{ft^2}$

$a := 0 \cdot ft$ Load applied from "a" to "b."

$b := d_{water}$

$A_1 := 0.5 \cdot e^{-\lambda \cdot a} \cdot \cos(\lambda \cdot a)$ $B_1 := 0.5 \cdot e^{-\lambda \cdot b} \cdot \cos(\lambda \cdot b)$

$A_2 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) - \cos(\lambda \cdot a))$ $B_2 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) - \cos(\lambda \cdot b))$

$A_3 := -0.5 \cdot e^{-\lambda \cdot a} \cdot \sin(\lambda \cdot a)$ $B_3 := -0.5 \cdot e^{-\lambda \cdot b} \cdot \sin(\lambda \cdot b)$

$A_4 := 0.5 \cdot e^{-\lambda \cdot a} \cdot (\sin(\lambda \cdot a) + \cos(\lambda \cdot a))$ $B_4 := 0.5 \cdot e^{-\lambda \cdot b} \cdot (\sin(\lambda \cdot b) + \cos(\lambda \cdot b))$

$R_1 := \frac{-2 \cdot w}{\lambda} \cdot (B_1 - A_1)$ Reaction at end. $R_1 = 2.54 \times 10^4 \frac{lbf}{ft}$

$M_1 := \frac{w}{\lambda^2} \cdot (B_4 - A_4)$ Moment at end. $M_1 = -1.07 \times 10^5 \frac{lbf \cdot ft}{ft}$

Note: R and M are given per unit width of wall. M>0 when producing compression at outside face.
Maximum negative moment and maximum shear occur at fixed end.

$V_{water} := R_1$ $M_{neg_water} := M_1$ $V_{water} = 2.54 \times 10^4 \frac{lbf}{ft}$ $M_{neg_water} = -1.07 \times 10^5 \frac{lbf \cdot ft}{ft}$

Maximum positive moment occurs at intermediate location near fixed end.

$x := 8.4 \cdot ft$ Location between "a" and "b."

$F_1 := \cosh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_2 := \cosh(\lambda \cdot x) \cdot \sin(\lambda \cdot x) + \sinh(\lambda \cdot x) \cdot \cos(\lambda \cdot x)$

$F_{a3} := \sinh[\lambda \cdot (x - a)] \cdot \sin[\lambda \cdot (x - a)]$ $F_{b3} := 0$ x < b.

$LT_M := \frac{-w}{2 \cdot \lambda^2} \cdot (F_{a3} - F_{b3})$

$M_{1A} := M_1 \cdot F_1 + \frac{R_1}{2 \cdot \lambda} \cdot F_2 + LT_M$ $M_{1A} = 1.134 \times 10^4 \frac{lbf \cdot ft}{ft}$

$M_{pos_water} := M_{1A}$ Maximum positive moment. $M_{pos_water} = 1.134 \times 10^4 \frac{lbf \cdot ft}{ft}$

Superpose solutions using load factors of 1.0 for lateral earth pressure and 1.0 for hydrostatic floodwater pressure. Hydrodynamic wave pressure is neglected since it is small in comparison to hydrostatic pressure.

$V := 1.0 \cdot V_{soil} + V_{water}$ $V = 3.402 \times 10^4 \frac{lbf}{ft}$

$M_{neg} := 1.0 \cdot M_{neg_soil} + M_{neg_water}$ $M_{neg} = -1.435 \times 10^5 \frac{lbf \cdot ft}{ft}$

$M_{pos} := 1.0 \cdot M_{pos_soil} + M_{pos_water}$ $M_{pos} = 1.51 \times 10^4 \frac{lbf \cdot ft}{ft}$

Calculate shear capacity of concrete wall per ACI 318, Section 11.3.1.
Assume dowels carry entire load.

$f_y := 60000 \cdot psi$ Yield strength of reinforcement.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of dowels at inside and outside faces.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of shear reinforcement.

$V_c := 0.85 \cdot 2 \cdot A_s \cdot f_y$ Shear capacity per one foot width of wall.

$V_c = 3.182 \times 10^5\,lbf$

Compare factored shear to shear capacity.

$V_u := V$ Factored shear. $V_u = 3.402 \times 10^4 \frac{lbf}{ft}$

$ratio := \frac{V_u \cdot 1 \cdot ft}{V_c}$ $ratio = 0.107$ OK.

Calculate moment capacity of concrete wall per ACI 318, Section 10.2.7.
Assume vertical rebar carries entire load.

$c := 5 \cdot in$ Concrete cover.

$b := 12 \cdot in$ Width of wall.

Check rebar at outside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at outside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 6.037 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := -M_{neg}$ Factored moment. $M_u = 1.435 \times 10^5 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.238$ OK.

Check rebar at inside face.

$d_s := 1.41 \cdot in$ Diameter of #11 rebar.

$d := t - c - 0.5 \cdot d_s$ Distance from extreme compression fiber to center of mass of tension reinforcement.

$A_s := 1.56 \cdot in^2$ Cross-sectional area of #11 rebar.

$s := 6 \cdot in$ Spacing of vertical rebar at inside face.

$A_s := A_s \cdot \frac{12 \cdot in}{s}$ $A_s = 3.12\,in^2$ Area of tension reinforcement.

$a := \frac{A_s \cdot f_y}{0.85 \cdot f_c \cdot b}$ Depth of concrete compression block.

$M_c := 0.90 \cdot A_s \cdot f_y \cdot (d - 0.5 \cdot a)$ Moment capacity per one foot width of wall.

$M_c = 6.037 \times 10^5\ lbf \cdot ft$

Compare factored moment to moment capacity.

$M_u := M_{pos}$ Factored moment. $M_u = 1.51 \times 10^4 \frac{lbf \cdot ft}{ft}$

$ratio := \frac{M_u \cdot 1 \cdot ft}{M_c}$ $ratio = 0.025$ OK.

Appendix 5
Section E
Groundwater
Monitoring

RCRA PART B PERMIT REAPPLICATION

FOR THE

IDAHO NATIONAL LABORATORY

VOLUME 22

IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

APPENDIX 5

SECTION E - GROUNDWATER MONITORING

MAY 2016

E. Groundwater Monitoring [IDAPA 58.01.05.008; 40 CFR 264.90 through 264.101]

In accordance with 40 CFR 264.90(a)(2), all solid waste management units must comply with the requirements in 40 CFR 264.101, corrective action for solid waste management units.

The corrective action requirements for the units covered by this permit application are addressed in the previously issued Volume 18 Idaho National Laboratory (INL) Idaho Nuclear Technology and Engineering Center (INTEC) Partial Permit Module VIII.

The groundwater monitoring requirements of 40 CFR 270.14(c), including IDAPA 58.01.05.008; 40 CFR 264.91 through 264.100, are not applicable to the Idaho Nuclear Technology and Engineering Center Calcined Solids Storage Facility buildings as these buildings are not landfills, surface impoundments, waste piles, or land treatment facilities.

Hydrogeologic information required by 40 CFR 270.14(b)(11) is addressed in Volume 3 of the INL HWMA/RCRA Part B Permit Application.

Appendix 6
Section J Corrective Action

RCRA PART B PERMIT

FOR THE
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APPENDIX 6

SECTION J - CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS

REVISION DATE: DECEMBER 17, 2025

J. Corrective Action For Solid Waste Management Units [IDAPA 58.01.05.008; 40 CFR 264.101]

Any RCRA corrective action required at Idaho Nuclear Technology and Engineering Center (INTEC) will be addressed under the Federal Facility Agreement and Consent Order (FFA/CO) or Module VII of the previously issued INTEC Waste Management Operations Partial Permit.

Appendix 7
Section K Other
Federal Laws

RCRA PART B PERMIT REAPPLICATION

FOR THE
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APPENDIX 7

SECTION K - OTHER FEDERAL LAWS

MAY 2016

K. Other Federal Laws [IDAPA 58.01.05.012; 40 CFR 270.14(b)(20), 40 CFR 270.3]

The subject for other federal laws applicable to waste management units at the Idaho National Laboratory (INL) is addressed in Section K in Volume 3 of the INL Resource Conservation and Recovery Act Part B Permit Application.

Appendix 8
Section L
Certifications

RCRA PART B PERMIT REAPPLICATION

FOR THE
IDAHO NATIONAL LABORATORY

VOLUME 22
IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER

CALCINED SOLIDS STORAGE FACILITY

APPENDIX 8

SECTION L - CERTIFICATION

MAY 2016

REGULATORY CERTIFICATION

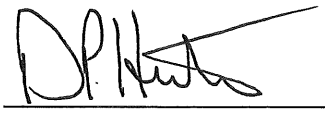
[IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

RCRA PART B PERMIT REAPPLICATION
FOR THE CSSF VOLUME 22 –MAY 2016

The undersigned certifies as required per IDAPA 58.01.05.012 [40 CFR 270.11(d) and 270.30(k)] as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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 Signature



Date: 5-5-16

David P. Hutchison, Vice President ESH&QA
CH2M WG-Idaho, LLC.

REGULATORY CERTIFICATION

[IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

RCRA PART B PERMIT REAPPLICATION
FOR THE CSSF Volume 22 – May 2016

The undersigned certifies as required per IDAPA 58.01.05.012 [40 CFR 270.11(d) and 270.30(k)] as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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 Signature

Frederick P. Hughes Date: 5/9/16

Frederick P. Hughes, Program Manager
Fluor Idaho, LLC

REGULATORY CERTIFICATION

[IDAPA 58.01.05.012; 40 CFR 270.11(d) and 270.30(k)]

RCRA PART B PERMIT REAPPLICATION
FOR THE CSSF VOLUME 22 – MAY 2016

The undersigned certifies as required per IDAPA 58.01.05.012 [40 CFR 270.11(d) and 270.30(k)] as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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.

Owner Signature

for

Date: 5/10/2016

Richard B. Provencher, Manager
Department of Energy Idaho Operations Office