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FUNCTIONAL REQUIREMENTS DOCUMENT (PREFINAL/90 PERCENT) AND DESIGN CRITERIA PACKAGE (PRELIMINARY/30 PERCENT), OPERABLE UNIT 4 REMEDIAL DESIGN/REMEDIAL ACTION

08/14/95

DOE-1347-95
DOE-FN EPAS
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REPORT

Department of Energy
Fernald Environmental Management Project
P. O. Box 538705
Cincinnati, Ohio 45253-8705
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AUG 1 4 1995
DOE-1347-95

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

FUNCTIONAL REQUIREMENTS DOCUMENT (PREFINAL/90 PERCENT) AND DESIGN CRITERIA PACKAGE (PRELIMINARY/30 PERCENT), OPERABLE UNIT 4 REMEDIAL DESIGN/REMEDIAL ACTION

Enclosed for your review and approval are the DRAFT Prefinal *Functional Requirements Document (FRD) Operable Unit 4 (OU4) Fernald Residues Vitrification Plant, August 1995*, and DRAFT Preliminary *Design Criteria Package (DCP), OU4 Fernald Residues Vitrification Plant, August 1995.*

These documents incorporate the recent agreement between the U.S. Environmental Protection Agency (U.S. EPA), the Ohio Environmental Protection Agency (OEPA), and the U.S. Department of Energy, Fernald Area Office (U.S. DOE-FN) to integrate completion of the OU4 remedial action with those of Operable Unit 3 (OU3) and Operable Unit 5 (OU5). This will be accomplished utilizing a phased approach consistent with the OU4 Record of Decision (ROD) as follows:

- Vitrification and final disposition of the Silos 1, 2, and 3 residues shall be implemented under the scope of OU4 in accordance with the OU4 ROD.

- Decontamination and Decommission (D&D) and final disposition of the silos and miscellaneous structures within the OU4 area will be implemented under the scope of OU3 in accordance with the OU4 and OU3 RODs.

- Soil and perched water remediation and final disposition shall be implemented under the scope of OU5 in accordance with the OU4 and OU5 RODs.

Recycled and Recyclable

If you should have any questions concerning this transmittal or require additional information, please contact Randi Allen at (513) 648-3102.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Allen

Enclosures: As Stated

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Design Criteria Package
Fernald Residues Vitrification Plant

CERCLA/RCRA Unit 4
August 1995
Preliminary (30%) - Revision 0

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

DRAFT

Design Criteria Package
Fernald Residues Vitrification Plant

APPROVED FOR ISSUE

Approved By:

Keith Hampton, CRU4 Engineering Manager, FERMCO — Date

Mark Dehring, FRVP Project Manager, FERMCO — Date

Mark Dehring, Acting CRU4 Director, FERMCO — Date

Randi Allen, OU4 Team Leader, DOE-FN — Date

DRAFT

Design Criteria Package
Fernald Residues Vitrification Plant

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ACRONYM LIST

AASHTO	American Association of State Highway and Transportation Officials
AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AFBMA	American Fan Bearing Manufacturers Association
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	American Refrigeration Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWT	Advanced Waste Water Treatment System
BAT	Best Available Technology
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDR	Conceptual Design Report
CRU4	CERCLA/RCRA Unit 4
CTI	Cooling Tower Institute
D&D	Decontamination and Decommissioning
DB	Dry Bulb
DBA	Design Basis Accident
DCP	Design Criteria Package
DCS	Distribute Control System
DOE	United States Department of Energy
DOT	United States Department of Transportation
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FEMP	Fernald Environmental Management Project
FPM	Feet per Minute
FSAR	Final Safety Analysis Report

ACRONYM LIST (Cont.)

FRD	Functional Requirements Document
FRVP	Fernald Residues Vitrification Plant
FS	Feasibility Study
GPM	Gallons per Minute
HEPA	High Efficiency Particulate Air Filter
HVAC	Heating, Ventilation, and Air Conditioning
ISA	Instrument Society of America
LLW	Low Level Waste
MSS	Manufacturers Standardization Society
MEI	Maximally Exposed Individual
NEMA	National Electrical Manufacturers' Association
NESHAP	National Emission Standards for Hazardous Air Pollutants
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NTS	Nevada Test Site
O&M	Operation and Maintenance
OAC	Ohio Administrative Code
ORC	Ohio Revised Code
OBBC	Ohio Basic Building Code
ODOT	Ohio Department of Transportation
OSHA	Occupational Safety and Health Administration
OTS	Offgas Treatment System
OU4	Operable Unit 4
pCi/l	Picocuries per Liter
pCi/g	Picocuries per Gram
PIV	Post Indicator Valve
PSAR	Preliminary Safety Analysis Report
PSIG	Pounds per Square Inch Gage
QA	Quality Assurance
RA	Remedial Action
RD	Remedial Design
RH	Relative Humidity
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

ACRONYM LIST (Cont.)

SAE	Society of Automotive Engineers
SCS	Soil Conservation Service
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TBC	To Be Considered
TBD	To Be Determined
TCLP	Toxicity Characteristic Leachate Procedure
TEMA	Tubular Exchanger Manufacturers Association
TM	Technical Manual
UBC	Uniform Building Code
UCRL	University of California Research Laboratory
μm	Micrometer
UPC	Uniform Plumbing Code
UPS	Uninterruptible Power Supply
UL	Underwriter's Laboratory
VOC	Volatile Organic Compound
VPP	Vitrification Pilot Plant
WB	Wet Bulb

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PROJECT GLOSSARY

Fernald Residues Vitrification Plant (FRVP) project is being implemented as part of the OU4 RD/RA under CERCLA. It includes all facilities associated with silo residue retrieval, treatment, packaging and staging for off-site shipment. The FRVP may include or share systems or facilities constructed for the Vitrification Pilot Plant. This has been previously referred to as the Silo Residue Retrieval/Treatment Facility (SRR/TF).

Vitrification Pilot Plant (VPP) project is being implemented in support of the OU4 RD/RA as a post-ROD Treatability Study.

New Radon Treatment System is the system to be used for the reduction of radon in the Silo 1 and 2 headspace in support of residue retrieval activities.

Design Criteria Package
Fernald Residues Vitrification Plant

1.0 PROJECT DESCRIPTION

The purpose of this document is to establish the design criteria along with the design basis for the Fernald Residues Vitrification Plant (FRVP) project at the Fernald Environmental Management Project (FEMP). OU4 is currently in the Remedial Design/Remedial Action (RD/RA) phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process which was initiated by the *Final Record of Decision for Remedial Actions at Operable Unit 4* (ROD) on December 7, 1994. The ROD can be summarized as the retrieval, stabilization by vitrification of the contents of Silos 1, 2 and 3, and off-site disposal at the Nevada Test Site (NTS), as well as the demolition, removal, and final disposition of the contaminated concrete, debris, and soils within OU4.

This Design Criteria Package (DCP) establishes the design criteria for the FRVP project that the remedial design shall meet. In addition, it establishes the design basis for the remedial facility which is a set of conditions, assumptions, and relationships upon which the design will be developed. The design criteria and design basis, together with the *Functional Requirements Document (FRD), Fernald Residues Vitrification Plant,* establish the technical baseline for the development of Title I and Title II design. This technical baseline allows for the tracking of the final detailed design back to its origin for future assessment of the design with respect to the project's original objectives and requirements.

This DCP was prepared to be consistent with the outline provided in the FEMP Engineering Procedure Number 12-4003, *Design Criteria Package, Revision 0.*

(It shall be noted that this 30% submittal contains incomplete information identified by bold face font, i.e., **xx pCi/l, TBD**. This information shall be completed in the 90% submittal of this document.)

1.1 Project Scope

The design requirements identified in this DCP cover only the FRVP.

Completion of the OU4 remedial actions will be via an integrated, site-wide approach as follows:

- Vitrification and final disposition of the Silos 1, 2, and 3 residues shall be implemented under the scope of OU4 in accordance with the OU4 ROD.

- D&D and final disposition of the silos and miscellaneous structures within the OU4 area will be implemented under the scope of OU3 in accordance with the OU4 and OU3 RODs.

- Soil and perched water remediation and final disposition shall be implemented under the scope of OU5 in accordance with the OU4 and OU5 RODs.

The first bullet identified above will be conducted under the FRVP project.

1.2 Project Limitations

The design life for the FRVP shall be 10 years.

The required glass output from the FRVP has been calculated at approximately 21.1 tons/day (FERMCO Letter No. C:CRUP(CRU4/RPP):95-0016, See Appendix B). This equates to a 3.2 year processing schedule of Silos 1, 2, and 3 material at 275 days/year, 24 hours/day, not including melter rebricking time. This shall be the design basis throughput for the FRVP. All systems within the functional areas of the FRVP shall be designed to meet the design basis throughput for the FRVP.

The location for the FRVP is to be immediately east of Silos 1 and 2, and south of the existing Vitrification Pilot Plant (VPP) (see Figure 1.2-1, FRVP Location). The VPP shall remain in place and operational (in cold standby) during operation of the FRVP. The physical constraints which limit the space allocations for locating the FRVP include the Paddy's Run Creek to the west of the silos, the High Nitrate Storage Tank and the OU2 Haul Road (future) to the east, the Biosurge Lagoon and OU1 waste pits to the north, and the OU5 wetlands to the south. In addition, the K-65 Trench will remain in place throughout this project; however, an approximately 100-foot section shall be removed to install utilities in support of the facility.

Figure 1.2-1, FRVP Location

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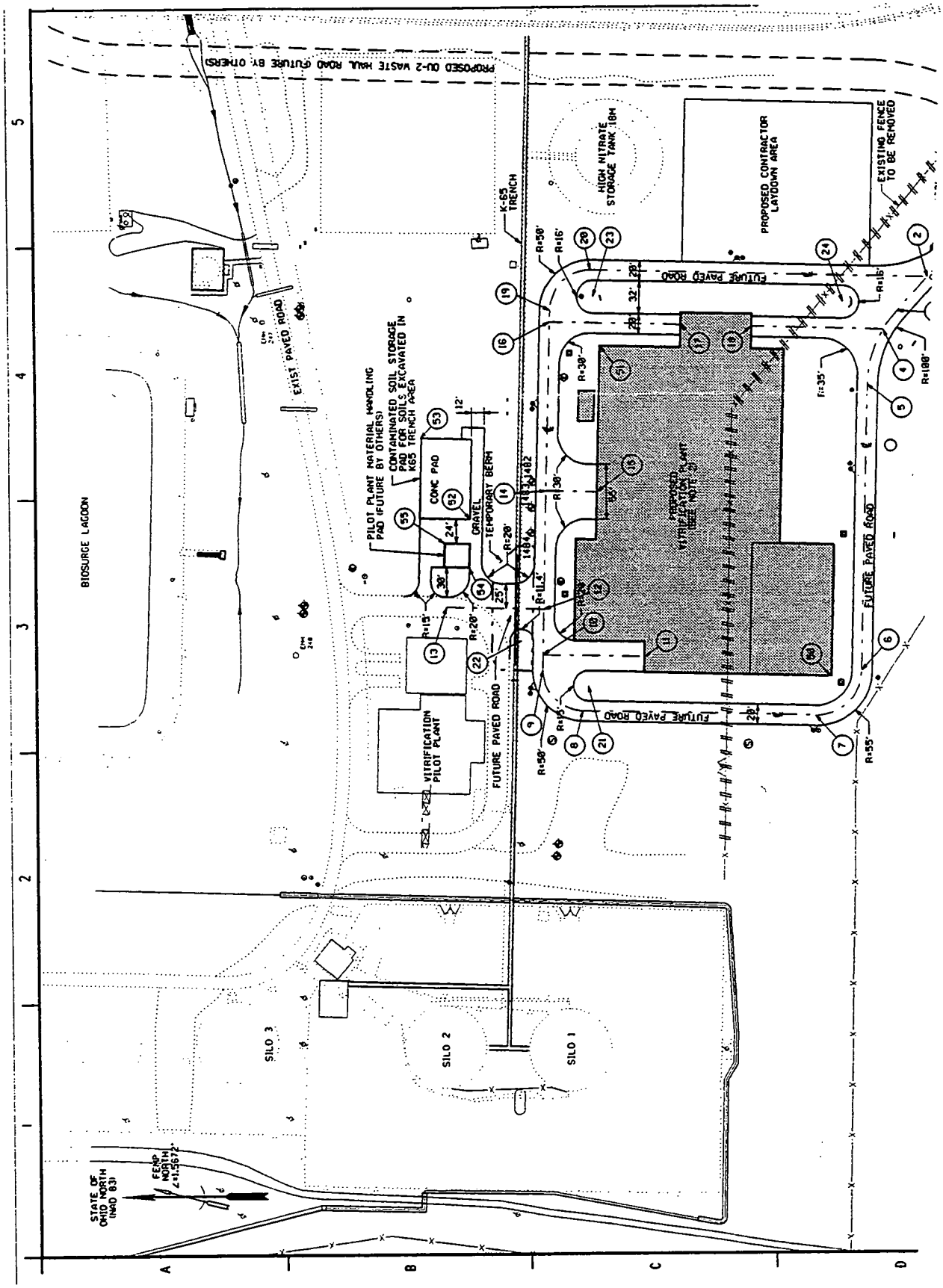

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1.3 General Operating, Maintenance, and D&D Requirements

1.3.1 Operations

The FRVP shall be designed with a central control room for the operation and monitoring of the residue retrieval, vitrification, and support operations. Local operation and monitoring shall also be provided for each system.

Equipment shall be accessible for ease of operation and maintenance. Systems which require radiological shielding shall allow for local operations, monitoring, and sampling outside of the shielding wall. Instrument readout shall be located at average eye level for ease of reading and controls. Valve handles shall also be located for ease of operation.

1.3.2 Maintenance

The process layout of the FRVP shall consider the need for potential equipment removal for maintenance or replacement while limiting the affects on production; specifically for that equipment with a design life less than that of the FRVP. As such, equipment egress routes shall be identified for this equipment. Maintenance is not required to be remote; however, contact and routine maintenance activities shall be limited in accordance with As Low As Reasonably Achievable (ALARA) principles where there is the potential for receipt of significant radiological dose relative to the FEMP site limits. The capability shall be provided to perform preliminary decontamination of equipment, where practical, before removal for maintenance or disposition.

1.3.3 D&D

The design of the FRVP shall facilitate decontamination so that the facility can be decommissioned as required by the OU4 ROD. The design shall consider the D&D requirements of Section 0205 of DOE Order 6430.1A.

1.4 General Description of the Project Components

The purpose of this section is to define <u>what</u> is to be designed in order to meet the functional requirements identified in the FRD. The FRVP is divided into seven functional areas as follows:

- Residue Retrieval - Includes the retrieval of residue from Silos 1, 2, and 3, including radiological and radon control, and transport to the vitrification feed preparation area.

- Vitrification Feed Preparation - Includes the receipt, conditioning, blending, and transport of residue and additives to the melter.

- Vitrification - Includes the metering of feed into the melter, vitrification, and discharge of the molten glass, all on a continuous basis.

- Glass Product Forming - Includes the receipt, forming, and cooling of molten glass discharged from the melter.

- Off-gas Treatment - Includes the treatment and monitoring of all process off-gas from the vitrification facility prior to release into the atmosphere.

- Glass Product Handling - Includes the receipt, containerization, transport, sampling, and shipment preparation of the final glass product. Also includes the remelt of any off-specification glass product.

- Wastewater Treatment - Includes the filtering and transport of the process waste water to the FEMP's wastewater treatment facility [Advanced Wastewater Treatment System (AWWT)].

The following sections further describe these functional areas including associated design limitations and constraints. Also identified are the key support areas and systems which are required for operation of the FRVP.

1.4.1 Residue Retrieval

Access Residue/Deploy Equipment

The residue in Silos 1 and 2 will be accessed from the top of each silo via independently supported superstructures. The superstructure design shall ensure that no additional load is

imposed on the silo dome and the retrieval equipment is centrally deployed through the silo dome. The superstructures shall include equipment and space provisions for residue retrieval equipment operation and maintenance including the necessary electrical power, air, instrumentation, and controls needed for remote operation from the vitrification facility control room. Also, water and slurry line hoses and pipes shall be extended from the superstructure to the existing pipe rack constructed under the VPP project for eventual connection to the vitrification facility.

An approximate 6- to 7-foot diameter central portion of the Silos 1 and 2 domes shall be removed to allow for residue retrieval equipment access *(Structural Evaluation of Silos 1, 2, 3, and 4 with 6-Foot Diameter Opening at Center Based on 1986 NDT Test Results, Rev. 0)*. The dome opening shall be fitted with the necessary transitions, doors, seals, and glovebags to re-establish and maintain radiological containment and radon control in both the waste retrieval operation and standby modes.

The superstructure currently located over Silo 4 shall be relocated over Silo 3 to support the retrieval of the Silo 3 residues. The superstructure shall be modified to provide access to all five manways to increase bulk material retrieval capabilities. The silo's existing manways shall be enlarged or modified, as necessary, for deployment of retrieval equipment (bulk and "heel"). The superstructure shall include equipment and space provisions for retrieval equipment deployment at each manway. A minimum of two manways shall be "on-line" (one active, one on standby) during retrieval operations to help ensure the availability of Silo 3 material for vitrification. Hands-on personnel activities required on the superstructure during retrieval operations shall be limited in accordance with ALARA principles. Provisions shall be included so that retrieval operations can be monitored for upset conditions from the vitrification facility control room. Also, hoses and pipes and required utilities shall be run from the superstructure to the existing pipe rack constructed under the VPP project for eventual connection to the vitrification facility. Modified manway covers, seals, bag-in/bag-out or other methods shall be used for radiological containment during retrieval operations and in the standby mode.

Hydraulic Retrieval

Bulk material retrieval from Silos 1 and 2 shall be performed with a hydraulic mining device. The mining system shall be a single deployment system capable of dislodging and pumping the bulk **(minimum xx %)** of the silo residue in slurry form (15-20% solids), from a central location, from the silo to the vitrification facility. Two mining systems are required (one for each silo); one operating, one on standby. This will help ensure the continuous availability of feed material at the vitrification facility.

High pressure water from the vitrification facility's recycle water loop shall be used to supply water for the mining systems. This water will be returned to the recycle water loop via the Thickener at the Feed Preparation System.

Pneumatic Retrieval

Silo 3 residue retrieval will be performed via pneumatic methods. A vacuum conveying system will be utilized to retrieve and transport the Silo 3 material directly to one or more storage bins at the vitrification facility. The conveying system shall be sized to meet the FRVP design basis throughput to allow the vitrification of Silo 3 material with or without mixing it with the K-65 material. The conveying system shall include all necessary in-line filter/receivers and HEPA filters for dust control. Exhaust from the conveying system shall be piped into the vitrification facility Offgas Treatment System (OTS) to maintain a single point release from the facility to the atmosphere. Provisions shall be made for the remote operation of the conveying system from the vitrification facility control room.

The vacuum equipment (e.g., vacuum pipes, vacuum nozzles) to be deployed into the silo shall be capable of dislodging or fluidizing the material to allow vacuuming of potentially packed material. Articulated vacuum nozzles shall be considered to ensure that the bulk of the silo material can be reached for retrieval and that the remaining heel is limited **(minimum xx %)**. The design shall accommodate for non-pumpable objects and their retrieval to limit the potential for residue retrieval downtime.

Heel and Object Retrieval

Retrieval of discrete, non-pumpable objects and "heel" residue retrieval (residue remaining in the silos following bulk retrieval operations) from Silos 1, 2, and possibly 3 shall be performed, as necessary, via a small robotic device being designed and supplied by the DOE Morgantown Energy Technology Center under a separate project. The Silos 1, 2, and 3 superstructures shall be designed to accommodate the operation of this robot system.

The robot shall be deployed from the superstructure through the enlarged opening in the silo domes. The robot will be in the form of a bulldozer, including transport tracks and a blade/squeegee for pushing the residue towards the inlet of a slurry pump. The robot shall have a manipulator to allow for object retrieval and size reduction, as necessary. The manipulator shall also allow for the spraying of water as needed to loosen heel material.

The robot system shall be readily relocated from one silo to another for operation as needed. Deployment of the robot shall limit hands-on personnel activities, as feasible. Operation of the robot shall be from a mobile control trailer, with backup control via a suitcase controller.

New Radon Treatment System

Due to the high concentration of radon gas in the Silos 1 and 2 headspace, a New RTS is required to support residue retrieval operations. The New RTS shall be capable of maintaining a negative pressure on the silos (minimum of negative 0.3 in. H_2O) and mitigate the release of radon during residue retrieval operations. This New RTS shall be designed with a stack for single point release to the atmosphere. If carbon beds are used for radon adsorption, they shall be insulated **(R=x)** to limit their temperature rise due to solar heat gain to maintain a minimum 85% carbon adsorption efficiency. The carbon beds shall be independent of the vitrification facility's OTS. The New RTS shall be designed to reduce radon concentrations in the Silo 1 or 2 headspace to approximately **xx pCi/l** within **x hours** to reduce gamma dose rates at the surface of the silo domes to allow for personnel access in support of residue retrieval or maintenance activities.

Provisions shall be made for the remote operation of the New RTS from the vitrification facility control room, including radon headspace, superstructure equipment room, and stack emission monitoring.

1.4.3 Vitrification Feed Preparation

Dewatering Residue

K-65 residue will be received at 15-20% solids from the Silos 1 and 2 residue retrieval systems. A thickener system shall be used to dewater the slurry to approximately 50 to 60 percent solids by weight. The Thickener system, Thickener Underflow Pumps, Flocculant Additive System, Spare Storage Tank and Pump, and the Recycle Water Pumps at the VPP shall be considered for use at the FRVP *(Vitrification Pilot Plant Integration Study, June 1995, Rev. 0)*. If used, this equipment shall be shared by the VPP and the FRVP so that both facilities can be operational (the VPP will likely be in cold standby during FRVP operation).

Batch Preparation

The thickened slurry shall be transferred via pipe to batch slurry tanks for glass formulation preparation. Provisions shall be made at the tanks for batch preparation including glass additives and Silo 3 material addition, water addition, blending to achieve a homogeneous mixture, and sampling. The design shall consider the need for batch weighing either via load cells at the slurry tanks or alternative methods. The size of slurry tanks shall take into account the time needed for batch preparation including sample and analysis (minimum of xx hours required). A minimum number of xx slurry tanks shall be provided. The slurry from the tanks to the melter shall be continuously recycled to the slurry tanks to help prevent settling of solids in the lines. In addition, provisions shall be made to flush-out the lines as necessary.

Silo 3 and Additive Material Receipt and Transfer

Silo 3 material shall be received at the vitrification facility in a storage bin. The bin shall, at a minimum, be sized to fill one slurry tank. This will ensure enough material to allow for a Silo 3-only batch to be vitrified without having to retrieve additional material from the silo. The bin shall provide for dust control.

Dry additives shall be received via a bulk storage bin system. Each additive bin shall be sized to hold a minimum 7 day supply of materials based on the highest percentage additive expected. The bulk additives shall be brought in by truck and pneumatically transferred to the appropriate storage bin. The bins shall provide for dust control. In addition, the pneumatic transfer system exhaust shall be filtered prior to release into the atmosphere. The following are the expected bulk additives and the weight percentages required to produce an acceptable quality glass:

Additive	Wt %
Borax	39
Alumina	16
Chalk (Calcite)	37
Washing Soda	8

This equates to an approximate 69% waste loading in the glass product as seen in Table 1.4-1, Melter Feed Formulation Basis.

The Silo 3 material and additives shall be transferrable to each slurry tank via a common feed hopper. A loss-in-weight feed hopper, equipped with dust control, shall be used to allow known amounts of Silo 3 and additive materials to be fed to the slurry tanks.

1.4.4 Vitrification

Melter

The prepared batch is to be fed into the melter from the slurry recycle loop. The melter design shall utilize electrical heating and shall vitrify on a continuous basis at temperatures between 1100° and 1350° Celsius with an agitated molten bath and will be capable of handling sulfates, nitrates, phosphates, and lead. The melter design shall provide a complete operational system including all necessary cooling (e.g., electrode, melter's outer surface, off-gas outlet) beyond that which a standard cooling tower or plant air could provide. The melter design shall also include slurry feed and molten glass discharge control, salt/sulfate surface drain capability, off-quality glass remelt and cold startup provisions, personnel access

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Table 1.4-1, Melter Feed Formulation Basis

Formula Description: All Silos per PNL Melt D14 Modified For Lower Melting Temperature, Etc.

Rod F. Gimpel V2.0 — 06/01/95

Component	Silo 1	Silo 1n	Silo 2	Silo 2n	Silo 3	Silo 3n	Bento-grout	Bento-grout n	Portions norm.	Portions in glass	Additives as oxides	Glass Result	Target Glass	Delta %
Al2O3	2.60	3.02	3.40	4.02	5.30	6.10	13.60	13.74	4.81	3.31	10.50	13.81	14.60	-0.79
As2O3			0.05	0.06	0.29	0.33			0.11	0.07		0.07		0.07
B2O3									0.00	0.00	9.70	9.70	9.70	0.00
BaO	6.30	7.32	3.00	3.54	0.03	0.04			3.74	2.57		2.57	3.30	-0.73
BeO	0.01	0.01		0.00	0.01	0.01			0.00	0.00		0.00		0.00
CO2	3.20	3.72	3.40	4.02	1.90	2.19			3.17	2.18		2.18 released		-
CaO	0.37	0.43	2.50	2.95	4.70	5.41	1.53	1.55	2.62	1.80	14.00	15.80	2.40	13.40
CdO					0.00	0.01			0.00	0.00		0.00		0.00
Ce2O3	0.41	0.48	0.33	0.39	0.02	0.02			0.30	0.20		0.20		0.20
CoO	0.19	0.22	0.21	0.25	0.36	0.41			0.27	0.18		0.18		0.18
Cr2O3	0.02	0.02	0.08	0.10	0.08	0.10			0.06	0.04		0.04		0.04
CuO	0.06	0.07	0.08	0.10	0.41	0.47			0.18	0.13		0.13		0.13
Fe2O3	2.50	2.90	6.10	7.20	8.00	9.21	3.07	3.10	5.95	4.09		4.09	5.40	-1.31
K2O	0.68	0.79	0.68	0.80	1.80	2.07	0.66	0.67	1.13	0.78		0.78	1.00	-0.22
La2O3	0.42	0.49	0.29	0.34	0.01	0.01			0.28	0.20		0.20		0.20
Li2O					0.47	0.54			0.15	0.10		0.10		0.10
MgO	1.20	1.39	1.70	2.01	10.00	11.51	5.40	5.46	4.56	3.13		3.13	4.00	-0.87
MnO2	0.01	0.02	0.03	0.04	0.67	0.77	0.05	0.05	0.23	0.16		0.16		0.16
MoO2	0.43	0.50	0.08	0.09	0.18	0.21			0.26	0.18		0.18		0.18
N2O5	0.29	0.34	0.62	0.73	6.10	7.02			2.24	1.54		1.54 released		-
Na2O	1.80	2.09	0.88	1.04	5.90	6.79	2.92	2.95	3.08	2.12	5.50	7.62	7.10	0.52
Nd2O3	0.19	0.22	0.16	0.19	0.01	0.01			0.14	0.10		0.10		0.10
NiO	0.42	0.49	0.36	0.43	0.52	0.60			0.47	0.32		0.32		0.32
P2O5	0.62	0.72	0.68	0.80	9.30	10.70	1.22	1.23	3.47	2.38		2.38	3.20	-0.82
PbO	12.00	13.93	6.20	7.32	0.19	0.22			7.34	5.05		5.05	6.40	-1.35
SO3	1.80	2.09	1.70	2.01	15.00	17.26			6.03	4.14		4.14 released		-
SeO2	0.05	0.05	0.04	0.05	0.03	0.03			0.04	0.03		0.03		0.03
SiO2	50.00	58.06	51.00	60.23	14.00	16.11	56.20	56.80	47.35	32.55	0.00	32.55	39.60	-7.05
SrO	0.08	0.10	0.06	0.07	0.03	0.03			0.07	0.04		0.04		0.04
ThO2					0.31	0.36			0.10	0.07		0.07		0.07
TiO2	0.28	0.33	0.33	0.39	0.22	0.25	0.22	0.22	0.32	0.22		0.22		0.22
UO2			0.47	0.56	0.34	0.39			0.28	0.19		0.19		0.19
V2O3	0.06	0.07	0.08	0.10	0.50	0.58			0.21	0.14		0.14		0.14
Y2O3					0.04	0.04			0.01	0.01		0.01		0.01
ZnO			0.01	0.01	0.07	0.08			0.02	0.02		0.02		0.02
ZrO2	0.05	0.06	0.14	0.17	0.02	0.02			0.08	0.05		0.05		0.05
									0.00	0.00		0.00		
Cl	0.08	0.09	0.00	0.01	0.02	0.02			0.04	0.03		0.03		0.03
F	0.00	0.01	0.00	0.01	0.08	0.09			0.03	0.02		0.02		0.02
Ignition loss							14.08	14.23	0.86	0.59		0.59 released		-
Total	86.12	100.00	84.68	100.00	86.90	100.00	98.95	100.00	87.70	60.30	39.70	100.00	98.70	3.30
Gases	5.29	6.14	5.72	6.75	23.00	26.47	14.08	14.23	12.30	8.46		8.46		

Ratios (dry wt.)	Silo 1	Silo 2	Silo 3	Bentonite	All Wastes	Additives	Total In	Glass	Gases	Total Out
Mass balance:	24.68	21.38	18.54	4.15	68.76	39.70	108.46	100.00	8.46	108.46
Silo mix Ratio	35.90	31.10	26.96	6.04	100.00	--	--	--	--	--

platforms and protection (e.g., radiological shielding, heat protection), and all instrumentation and controls to allow for remote operation and monitoring from the vitrification facility control room. The melter shall also be designed for minimal off-gas generation (e.g. cold cap operation, electric heated) with all off-gases exiting through a single point discharge for tie-in to the vitrification facility's induced draft off-gas system. The melter off-gas discharge shall be designed to limit glass build-up and shall include a method for clearing build-up to eliminate the chance for pluggage. The melter design shall account for operation in a standby mode (no throughput) in the case of process upset, safe shutdown as required for melter maintenance activities, and an emergency off-gas venting system to prevent pressurization of the melter.

The design shall provide for three, 8 Ton/day glass melters. The design life of the melters, specifically the refractory brick and electrodes, shall exceed the expected operating life of the FRVP, if possible. Each melter shall be capable of being isolated from the process to allow for maintenance without total production shutdown. The melters shall be designed to discharge to a Product Forming System.

The melter shall be designed based on the feed composition basis shown in Table 1.4-1.

1.4.5 Glass Product Forming

Gem Form

The molten glass from the melters will be discharged to dedicated (one or more per melter) gem forming machines. The gem machine shall be designed to form the glass into a gem shape and to cool the gems without adversely affecting the glass structure to help ensure the glass meets the waste acceptance criteria. The gem machine design shall provide a complete operational system including all necessary cooling systems for the gems beyond that which a standard cooling tower or plant air could provide. The gems shall be cooled to a max temperature of xx ° F prior to discharging to the shipping containers. The gem machine design shall also include glass discharge control to shipping containers, heat load ventilation, personnel access platforms and protection (e.g. radiological shielding, heat protection) as needed, and all instrumentation and controls to allow for remote operation and monitoring from the vitrification facility control room. The gem machine shall be designed to ensure

limited hands-on operations and maintenance activities in accordance with ALARA principles.

1.4.6 Off-Gas Treatment

Prior to being discharged to the atmosphere, all contaminated and potentially contaminated off-gas from the vitrification facility, i.e, melters, tanks, etc., shall be sent to the OTS for radon, particulate, and acid gas removal to meet emission requirements identified in the ARARs. (Refer to Table 1.4-1 for the expected off-gas wt% and components resulting from the melter feed. Note that components will likely be in an alternate chemical form than shown in the table.) The OTS shall be a continuously operating, induced draft type system sized to service the entire vitrification facility. The OTS shall be designed to accommodate effluent surge conditions that could result during operation of the melters. The surges would be a result of rapid steam generation that occurs when the slurry feed contacts the molten glass through possible fissures in the cold cap. The system shall be designed to maintain a negative pressure relative to the vitrification area under maximum potential surge conditions.

The OTS will discharge to the atmosphere via a single point exhaust stack. The off-gas system design shall provide for all instrumentation, alarms, sampling, and controls necessary to operate and monitor the system both locally and from the vitrification facility control room.

<u>Reduce Temperature</u>

The melter off-gas shall be initially cooled and condensed in a water spray quench tower to a maximum temperature of 115° F to protect down-stream equipment. The vitrification facility's recycle water loop shall supply the water. The gas shall be further cooled to aid radon adsorption as described under "Reduce Moisture" below.

<u>Remove Solids</u>

All process off-gas streams containing particulates shall be considered for treatment via a scrubber system. The scrubber shall be designed for 95% particulate removal at 1 μm. The water for this system shall not be supplied by the vitrification facility's recycle water loop.

Treat Acid Gas

An SO_x removal system shall be included in the OTS prior to discharging to the atmosphere. SO_2 removal shall be at a minimum of 99%. Caustic addition shall be provided as necessary. An NO_x removal system shall be required if the expected NO_x emissions will exceed 40 tons/year in accordance with ARAR requirements, or if VPP testing identifies the need for NO_x removal from the off-gas prior to entering the carbon beds.

Reduce Moisture

To help increase the efficiency of the down-stream carbon beds and HEPA filters, a dryer/refrigeration system shall be included in the OTS upstream of the carbon beds and HEPA filters. All process off-gas streams that pass through the carbon beds and HEPA filters in the OTS shall first pass through the dryer/refrigeration system. The dryer/refrigeration system shall be capable of reducing moisture in the gas stream from 100% relative humidity to 15% maximum, and temperature to approximately 4° to 7° Celsius.

Reduce Radon

All process off-gas streams that potentially contain radon must be passed through carbon beds (or alternate technology) for radon reduction. The carbon beds shall reduce the radon in the off-gas stream at a minimum of 85% efficiency and shall be sized so as not to require carbon changeout during the expected operating life of the FRVP. The beds shall be insulated to limit their temperature rise, due to solar gain, to maintain a minimum 85% carbon adsorption efficiency.

Final HEPA Filtration

As a final particulate filtration prior to being discharged to the atmosphere, all streams of the OTS shall pass through HEPA filters. A minimum of two filter trains are required (one on-line, one on standby), isolated by leakproof dampers, to allow for continuous operation of the OTS during filter changeout. The design shall also allow for in-place DOP testing in accordance with FEMP site procedure 20-C-707, *DOP Testing of In-Place HEPA Filters.*

Exhaust Stack

A single exhaust stack shall be utilized for the vitrification facility to facilitate monitoring and control of emissions to the atmosphere. Provisions shall be made at the stack for continuous isokinetic sampling and radon and radiological monitoring, as well as grab samples.

1.4.7 Glass Product Handling

Containerization and Transfer

The glass gems shall be discharged from the gem machine into shipping containers (see Section 2.2.3 for container size and requirements). The containers shall be continuously weighed as they are being filled and, upon reaching a pre-established set point, shall automatically shut off discharge from the gem machine. Conveyors shall transfer the containers to and from the discharge point of the gem machine. Operation of the conveyors shall be from a remote location. Use of a forklift to transport containers to and from the product handling system shall be considered relative to ALARA practices; otherwise, alternate methods shall be utilized.

Provisions shall be made for the recycling of off-quality glass back into the process for remelt. This operation shall be designed to limit worker radiation dose.

Staging Area and Interim Storage Area

Full containers shall be transferred to a staging area for cooling, sampling, lidding, and labeling/bar coding. Monitoring of container temperature shall be provided. The containers shall be bar coded for traceability in the event that sampling and analysis shows a batch of glass not meeting the waste acceptance criteria. The containers shall then be transferred to an Interim Storage Area (28 day capacity) located at the FRVP where it will await shipment. The Interim Storage Area shall be sized for a 28 day production capacity which is based on a reasonable worst-case scenario of a 2-week shipment delay which occurs either immediately prior to or following the annual 2-week NTS shutdown (*Interim Product Storage Study, May 1995, Rev. 0)*.

The Interim Storage Area shall serve as a holding area prior to receipt of waste acceptance criteria verification. During the laboratory analyses of the glass, the containers shall be

managed in accordance with the RCRA requirements included in the ARAR list until a non-hazardous determination is made. The Interim Storage Area shall be designed to meet these requirements.

A truck loadout area to accommodate a standard side loading 18-wheeler truck shall be provided at the Interim Storage Area for off-site shipment of the containers.

1.4.8 Wastewater Treatment

Based on the capacity limits of the AWWT **(xx gpm)**, the design shall consider the use of a holding tank or alternate means to control the wastewater discharge from the FRVP to the AWWT.

Suspended Solids

Any surplus of water resulting from the vitrification process shall be discharged from the process via a wastewater bleed off stream. This wastewater shall be transferred via pipeline to the FEMP AWWT system for treatment prior to off-site discharge. However, prior to leaving the process, suspended solids shall be reduced via regenerating media filters designed for removal of particles down to 10 μm. The solids shall be returned (recycled) to the vitrification process as the filters are backwashed (regenerated).

Dissolved Radon

Wastewater with potentially significant concentrations of dissolved radon shall pass through a radon stripping system prior to being discharged from the process to the AWWT. The radon stripping system shall utilize compressed air and electric heat within a water holding tank to "strip" the radon from the water. Radon shall be removed from the water down to a maximum concentration of xxx,xxx pCi/L.

1.4.9 Support Areas and Systems

In support of the functional areas of the FRVP, several key support areas and systems are necessary. A support area is defined here as the structures and specific rooms required to house equipment and personnel. Support systems are those systems and equipment required to support the process and operation of the vitrification facility. The support areas and

systems, and a description of each follows. In addition, the primary support utilities, i.e., process water, potable water, electric power, sanitary waste treatment system, etc., that shall be provided by existing FEMP sources are discussed.

Vitrification Building

A building shall be used to house the vitrification and containerization area, the laboratory, the staging and interim storage area, and all personnel and operations support rooms. The building shall provide for personnel and equipment access, secondary containment, heating, ventilation and air conditioning (HVAC), and radiological shielding and controls, as necessary, to separate the potentially controlled vitrification/containerization and laboratory areas from the support rooms and interim storage area. The key support rooms have been identified as follows; however, this is not intended to limit the building design or the need for additional support rooms as warranted:

Electrical Equipment Room - to house the main unit substation, motor control centers, uninterruptible power supply, etc.

Process Control Room - to house the distributed control system (DCS), video monitors, etc.

Maintenance Room - to provide for routine maintenance activities and store the critical spare parts and supplies.

Personnel Change Rooms - to include wash basins and lockers for the operations personnel. Change rooms shall be used to don and doff Anti-Cs/PPE and to store coats, footwear, or personal belongings that would not be taken into the potentially radiologically controlled process area. The existing FEMP Services Building (Building 11) shall be used for shower facilities and initial dressout in FEMP issued clothing. Restrooms shall be provided at the FRVP.

Offices - to house shift supervisors, QA, laboratory, radiological technician, and administrative support personnel.

Break Room - to provide a non-food break area for breaks to be taken by the operations and support personnel.

Viewing Area - to provide a non-contaminated area designated for public viewing of the melter/product forming operation in support of public relations activities, i.e., small tours of 10 people maximum. The viewing area shall utilize shielded viewing windows or closed circuit televisions as warranted.

Refer to Section 2.3.3, Architectural, for the estimated number of personnel for which the building and its facilities shall be designed.

Laboratory

A laboratory area located at the vitrification facility shall be sized and equipped to allow for batch preparation sample analyses, crucible melt verification, as well as all other routine in-process sample analyses as required to monitor and maintain the process within control limits. Due to the handling of non-vitrified K-65 and Silo 3 residue during sample analyses, the laboratory shall be located in the radiologically controlled area of the vitrification facility. The laboratory fume hoods shall be equipped with local status (on, off) indicators.

Process Pad

The remaining process areas, such as the feed preparation and OTS, shall be placed on open pads. The design shall consider covering the pads with a roof to help segregate stormwater from potentially contaminated areas and to reduce the load on the AWWT. If covered pads are not used, provisions shall be made to segregate stormwater collected on the general pad from that collected within potentially contaminated tank dikes. See Section 2.2.3, Stormwater, for the stormwater management requirements. Grated trenches and sumps shall be used for pad liquid transfer and collection, rather than floor drains. Radiological shielding shall be provided around equipment as radiation levels dictate. Dikes and curbs shall be provided for tank leak containment and stormwater run-on control.

Transfer equipment, waste routing lines, and sufficient additional storage capacity shall be installed and available to permit the transfer of the contents of one tank to another if it shows

indication of conditions that warrant taking the tank out of service. The minimum spare volume shall exceed the maximum liquid content of the largest tank plus rainfall and wave action.

HVAC

HVAC shall be provided for the building. This includes the HVAC required to protect support equipment, maintain negative pressure in contaminated areas, direct air flow from less contaminated areas to more contaminated areas, and provide for compliance with Occupational Safety and Health Administration (OSHA) area standards. See Section 2.3.5, HVAC, for specific design requirements.

Cooling Water

A packaged cooling tower shall be utilized to provide cooling water to the FRVP as required by the vitrification process. Use of the FEMP site cooling tower shall not be considered for the FRVP. Refer to Section 2.3.4, Cooling Towers, for design requirements.

Electric Power

The existing FEMP 13.2 kV distribution system shall be used to supply electric power to the FRVP via switchgears, motor control centers, and distribution panels. Feeders shall be chosen based on power requirements versus availability and close proximity to the FRVP. The FEMP site is served by two independent 132 kV lines. The supply bus is connected to three 10,000/12,500 kVA transformers which supply two 13.2 kV distribution buses. The buses are cross connectable by a cross tie breaker which is normally open. Each of the two distribution buses provide two feeder lines. Four standby, automatic starting, diesel generators serve the FEMP Communication Center, Services Building, Sewage Treatment Plant, Sewage Lift Station, and Maintenance Building.

A diesel generator(s) and Uninterruptible Power Supply(s) (UPS) shall be used to provide standby or emergency electric power to all critical process equipment, support systems, or safety class items of the FRVP. Refer to Section 2.3.7, Electrical, for electrical design requirements.

Plant Air/Breathing Air

Provisions shall be made to supply plant air and emergency breathing air in support of residue retrieval and vitrification operations. Plant air shall be of instrument air quality. Breathing air shall comply with OSHA standards. The availability of plant air and breathing air from the existing FEMP system is questionable; therefore, a local air supply system is required for all necessary air uses at the FRVP. The air line in the K-65 Trench, which is supporting the VPP as backup air, shall not be considered as a primary source of plant air.

Process and Potable Water

Provisions shall be made to supply process and potable water, as needed, to support the FRVP. Existing FEMP process and potable water lines shall be extended to the FRVP as the source of this water. The FEMP Water Treatment Plant treats well water and discharges it to a common 750,000 gallon storage tank. Separate pumps and distribution headers are used for the process and potable water. The nominal operational pressure of all water supplies is 75 psig. Potable water shall be used for restrooms, faucets, drinking fountains, and safety showers/eye wash stations. Process water shall be used for non-sanitary requirements. Refer to Section 2.3.1, Water Distribution Systems, for design requirements.

Fire Protection Water

The existing FEMP fire water supply system shall be used by the FRVP. Refer to Section 2.3.5, Fire Protection, for design requirements. The FEMP fire water supply system consists of one 350,000 gallon, 245 feet elevated tank that maintains an approximate static pressure of 115 psi on the distribution system. If demand reduces system pressure to 100 psi, an electric, motor driven centrifugal pump automatically starts, taking suction from a 300,000 gallon ground level storage tank. If pressure still cannot be maintained, a second diesel motor driven pump starts automatically. The third diesel motor driven pump can be started manually, if necessary. Each pump has a capacity of 2,000 gpm with a 123 psi differential pressure total dynamic head. For redundancy, the fire water supply is cross connectable between the FEMP potable or raw well water supplies.

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Sanitary Sewer

The existing FEMP sanitary sewer/treatment system shall be used by the FRVP. Sanitary sewer line tie-in points shall be chosen based on their close proximity to the FRVP and ease of installation. Lift stations shall be considered only when gravity flow design for transfer to the FEMP Sewage Treatment Plant is not feasible (Refer to Section 2.3.1, Sanitary Wastewater Systems, for design requirements).

Distributed Control System (DCS)

A DCS shall be utilized for the control, monitoring, and data acquisition for the FRVP and to help limit personnel requirements for facility operations. The system shall be designed to control the processes in such a way that risks to the worker and the environment are mitigated under normal and upset conditions. Refer to Section 2.3.8, Instrumentation and Controls, for DCS design requirements.

Telecommunications

A telephone system shall be provided for the FRVP. All normally occupied parts of the facility, and those locations as determined necessary for operations and safety, shall have telephone conduits installed to accommodate internal and external communications, as warranted. Refer to Section 2.3.7, Exterior and Interior Communications and Alarm Systems, for design requirements.

Computer access to the FEMP network shall also be provided at the FRVP via the telephone lines.

1.5 References

The following are the primary documents on which this DCP is based.

1. United States Department of Energy, 1987/1992, *DOE Order 4700.1, Project Management System.*

2. United States Department of Energy, 1989, *DOE Order 6430.1A, General Design Criteria.*

3. FEMP Engineering Procedure, *Document No. 12-4003, Design Criteria Package, September 1994, Rev. 0.*

4. United States Department of Energy, *Functional Requirements Document, Fernald Residues Vitrification Plant, August 1995, Rev. 0 (Prefinal).*

5. FERMCO and Parsons, FEMP-2319, Site Safety Analysis Reference Report, March 1994, Rev. 1.

2.0 DESIGN CRITERIA

This section identifies the general and discipline-specific design criteria to which the design shall comply. The FRVP shall be designed based on the requirements of a Non-Reactor Nuclear Facility (Special Facility) under DOE Order 6430.1A. It shall be noted that although Section 2.3, Discipline Criteria, references specific requirements from DOE Order 6430.1A that the design must meet, this does not remove the requirement for the design to meet all other applicable DOE Order 6430.1A requirements not specifically listed in this DCP, specifically those for Special Facilities as defined by DOE Order 6430.1A.

2.1 Functional Requirements

The functional requirements for the FRVP are listed in the FRD for this project (reference No. 4 under Section 1.5 of this document).

2.2 General Criteria

State, municipal, and local building codes shall be followed unless they conflict with DOE Order 6430.1A.

2.2.1 National, State, and Local Codes, Standards, and DOE Orders

This section presents the general laws, regulations, codes, standards, guidelines, and orders that shall be followed for the design of the FRVP. This information is organized by engineering discipline.

<u>Architectural</u>

1) DOE Order 5480.10, "Contractor Industrial Hygiene Program"
2) 10 CFR Part 835, "Radiation Protection for Occupational Workers"
3) National Fire Protection Association (NFPA) 101, "Code for Safety to Life from Fire in Buildings and Structures"
4) NFPA 13, "Installation of Sprinkler Systems"
5) Ohio Basic Building Code (OBBC) (1994)
6) Uniform Building Code (UBC) (1994)
7) NFPA 75, "Protection of Electronic Computer/Data Processing Equipment"
8) Metal Building Manufacturers Association - Recommended Design Practice Manual

Civil

1) American Association of State Highway and Transportation Officials (AASHTO), "GDHS-90 Policy on Geometric Design of Highways and Streets," 1990, by AASHTO
2) American Society of Civil Engineers (ASCE) 37, "Design and Construction of Sanitary and Storm Sewers," ASCE
3) North American Datum of 1983.
4) North American Vertical Datum of 1929.
5) NFPA 24, "Installation of Private Fire Service Mains and their Appurtenances"
6) Soil Conservation Service (SCS), "TR-55 Urban Hydrology for Small Watersheds," Technical Release 55, SCS
7) Technical Manual (TM) 5 814-1, "Sanitary and Industrial Wastewater Collection - Gravity Sewers and Appurtenances," U.S. Dept. of Army
8) TM 5 814-2, "Sanitary and Industrial Wastewater Collection - Pumping Stations and Force Mains," U.S. Dept. of Army
9) Technical Paper-40, "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," National Weather Service
10) DOE-STD-1020-94, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities"
11) "Water Management and Sediment Control to Urbanizing Areas," SCS
12) FEMP Stormwater Pollution Prevention Plan for construction activities
13) Ohio Department of Transportation (ODOT), Location and Design Manual, Volume Two, Drainage Design
14) ODOT, Construction and Material Specifications

Electrical

1) American National Standards Institute (ANSI) C2, National Electrical Safety Code
2) ANSI C84.1, Electrical Power Systems and Equipment - Voltage Ratings (60 Hz)
3) NFPA 70, National Electrical Code
4) NFPA 780, Lightning Protection Code

Fire Protection

1) 29 CFR 1910, Occupational Safety and Health Standards

2) DOE Order 5480.7A, "Fire Protection"

3) NFPA Fire Code Documents

(1) NFPA 11, Low Expansion Foam and Combined Agent Systems
(2) NFPA 11A, Medium- and High-Expansion Foam Systems
(3) NFPA 12, Carbon Dioxide Extinguishing Systems
(4) NFPA 13, Installation of Sprinkler Systems
(5) NFPA 14, Installation of Standpipe and Hose Systems
(6) NFPA 15, Water Spray Fixed Systems for Fire Protection
(7) NFPA 16, Installation of Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems
(8) NFPA 16A, Installation of Closed-Head Foam-Water Sprinkler Systems
(9) NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances
(10) NFPA 30, Flammable and Combustible Liquids Code
(11) NFPA 72, National Fire Alarm Code
(12) NFPA 75, Protection of Electronic Computer/Data Processing Equipment

Instrumentation

1) NFPA 70, National Electrical Code

2) ISA, Instrument Society of America

Material Handling

1) American Welding Society (AWS) D1.2-92 Structural Welding Code Steel

2) ANSI MH 27.1-1981 - Specifications for Underhung Cranes and Monorail Systems

3) ASCE 7-93, Minimum Design Loads for Buildings and Other Structures

4) American Society of Mechanical Engineers (ASME) - Boiler and Pressure Vessel Code - Section VIII-92

5) American Society for Testing and Materials (ASTM) A36/A36M-91, Standard Specification for Structural Steel

6) Crane Manufacturers Association of America 74-1987 - Specifications for Top Running and Under Running Single-Girder Electric Overhead Traveling Cranes

7) 29 CFR 1910, Occupational Safety and Health Standards

8) ANSI B30.16-87, Overhead Hoists

9) ANSI B30.10-87, Hooks

10) ANSI HST-4M-91, Performance Standard for Overhead Electric Wire Rope Hoists
11) AFBMA 9-90, Load Rating Standard for Ball Bearings
12) AFBMA 11-90, Load Rating Standard for Roller Bearings
13) DOE/ID-10500, Doe - Hoisting and Rigging Manual
14) SAE J516-92, Hydraulic Hose Standard
15) SAE J517-91, Hydraulic Hose Standard
16) SSPC-SP6-91 Surface Preparation Specification No. 6, Commercial Blast Cleaning
17) UBC, Uniform Building Code, 1994

Mechanical Process Vessels and Equipment

1) American Petroleum Institute (API) Standards:
   (1) 620-90, "Design and Construction of Large, Welded, Low-Pressure Storage Tanks"
   (2) 650-93, "Welded Steel Tanks for Oil Storage"
2) American Society of Mechanical Engineers (ASME):
   (1) B73.1 M-91, "Specification for Horizontal End Suction Centrifugal Pumps"
   (2) Unified Pressure Vessel Code
3) Tubular Exchanger Manufacturers Association (TEMA) Standards, 1988

Mechanical Utilities

1) AABC National Standards for Total System Balance
2) American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation
3) Air Moving and Conditioning Association 210, Laboratory Method of Testing Fans
4) ANSI Z358.1, Eyewash and Shower Equipment, Emergency
5) ARI 460, Remote Mechanical Draft Air-Cooled Refrigerant Compressors
6) ARI 520, Positive Displacement Refrigerant Compressors and Condensing Units
7) ARI 550, Centrifugal Water Chilling Packages
8) ARI 590, Reciprocating Water Chilling Packages
9) ARI 1010, Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers
10) American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)-1993, Handbook of Fundamentals

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11) ASHRAE 15, Safety Code for Mechanical Refrigeration
12) ASHRAE 20, Methods of Testing for Rating Remote Mechanical Draft Air-Cooled Refrigerant Condensers
13) ASHRAE 5125, Thermal Environmental Conditions for Human Occupancy
14) ASHRAE 62, Ventilation for Acceptable Indoor Air Quality
15) ASHRAE 90.1-1989, Energy Conservation in New Building Design
16) ASME N510-89, Testing of Nuclear Air-Cleaning Systems
17) 29 CFR 1910, Occupational Safety and Health Standards
18) CTI Bulletin ATC-105, Test for Water Cooling Towers
19) DOE 6430.1A, "General Design Criteria"
20) DOE/TIC-11603-Rev I, Standards and Criteria Guide Non-Reactor Nuclear Facilities
21) ERDA 76-21, Nuclear Air Cleaning Handbook
22) FS-WW-P-541 Series, Plumbing Fixtures
23) NFPA 90A, Installation of Air Conditioning and Ventilating Systems
24) NFPA 91, Installation of Exhaust Systems for Air Conveying Material
25) Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) 75, Accepted Industrial Practice for Industrial Ducts
26) SMACNA 77, Round Industrial Duct Construction Standards
27) Underwriter's Laboratories (UL) 207, Refrigerant-Containing Components and Accessories, Non-Electrical
28) UL 900, Test Performance of Air Filter Units
29) Uniform Plumbing Code (UPC) (1991)
30) DE-89-000406, Health Physics Manual of Good Practices for Reducing Radiation Exposure
31) NFPA-45, Fire Protection for Laboratories Using Chemicals
32) OBBC, 1994
33) OSHA Standards
34) National Electrical Manufacturers' Association (NEMA)

<u>Nuclear and Systems Safety</u>

1) American Concrete Institute (ACI) 318, Building Code Requirements for Reinforced Concrete
2) ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures

3) American Nuclear Society (ANS) 6.4, Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants
4) ANS 6.4.2, Specifications for Radiation Shielding Material
5) ANSI N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
6) DOE-DP-STD-3005-93, Definitions and Criteria for Accident Analysis
7) DOE-STD-1021-93, "Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components"
8) DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, "Nuclear Safety Analysis Reports"
9) DOE Order 5400.1, "General Environmental Protection Plan"
10) DOE Order 5480.10, "Contractor Industrial Hygiene Program"
11) 10 CFR 835 "Occupational Radiation Protection"
12) DOE Order 5480.23, "Nuclear Safety Analysis Reports"
13) DOE Order 5480.28, "Natural Phenomena Hazards Mitigation"
14) NFPA 101, Life Safety Code

<u>Piping</u>

1) ASME B31.3, Chemical Plant and Petroleum Refinery Piping
2) ASME Boiler and Pressure Vessel Codes
3) ASTM A-36, Structural Steel
4) ASTM A-576, Steel Bars, Carbon, Hot-Wrought, Special Quality
5) ASTM B209, Aluminum and Aluminum Alloy Sheet and Plate
6) ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation
7) ASTM C552, Cellular Thermal Insulation
8) AWS D.1.1, Structural Welding Code - Steel
9) DOE Order 6430.1A, "General Design Criteria"
10) Manufacturers Standardization Society (MSS) SP-58, Pipe Hangers and Supports - Material, Design, and Manufacture
11) MSS SP-69, Pipe Hangers and Supports Selection and Application
12) MSS SP-89, Pipe Hangers and Supports Fabrication and Installation Practices
13) OSHA 29 CFR 1910
14) TEMA

Structural

1) ACI 318-89, Building Code Requirements for Reinforced Concrete
2) American Institute of Steel Construction Manual, 9th Edition
3) ASCE 7-93, Minimum Design Loads for Buildings and Other Structures
4) OBBC (1994)
5) DOE Order 5480.28, "Natural Phenomena Hazards Mitigation"
6) DOE-STD-1020, 1994, "Natural Phenomena Hazards Design and Evaluation Guidelines for DOE Facilities"
7) DOE-STD-1021, 1993, "Natural Phenomena Hazards Performance Categorization Criteria for Structural, Systems and Components"
8) TM-5-809-10.1, Seismic Design Guidelines for Essential Buildings
9) TM-5-809-10.0, Seismic Design for Buildings
10) UBC (1994)
11) UCRL-53526, Rev. 1, Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy Sites
12) UCRL 53582, Rev. 1, Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for Department of Energy Sites
13) Metal Building Manufacturer's Association - Recommended Design Practice Manual

2.2.2 Environmental Requirements

Appendix A presents the list of ARARs and TBC criteria which shall be followed during FRVP design. This list includes a "Strategy for Compliance" to indicate how the requirements that impact design will be met.

2.2.3 Requirements for Waste Streams

The following are the primary waste streams that are expected to be generated during construction and operation of the FRVP. These streams include:

1) Glass
2) Off-gas
3) Process wastewater
4) Stormwater
5) Sanitary waste

6) Solid waste (Office, Construction, Process)
7) Laboratory waste
8) Contaminated Soils and Debris

The discussions that follow identify the requirements relative to the management and disposition of each waste stream.

Glass

The vitrified waste stream will be shipped to NTS for final disposition. As such, the *Nevada Test Site/Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, NVO-325, Revision 1, June 1992*, identify the waste acceptance criteria (WAC) that this waste stream shall meet and applies to this waste stream as follows:

1) Low level waste (LLW) shall contain less than 0.5 percent free liquid by volume.
2) Fine particulate wastes shall be immobilized so that the waste package contains no more than 1 wt% of less-than 10 um diameter particulates, or 15 wt% of less than 200 μm diameter particles.
3) LLW gases shall be stabilized or absorbed so that pressure in the waste package does not exceed 1.5 atmospheres at 20° Celsius.
4) Where practical, waste shall be treated to reduce volume, promote waste minimization, and provide a more structurally and chemically stable waste form.
5) LLW shall contain less than 1 percent chelating or complexing agents by weight.
6) LLW shall contain less than 50 ppm polychlorinated biphenyls (PCBs).
7) Materials shall not be a Transuranic (TRU) Waste.
8) Materials shall be packaged in accordance with DOE Order 1540.1 and DOT requirements under 49 CFR 173 (see packaging requirements below).
9) Materials shall not be a hazardous waste or exhibit a hazardous characteristic.

Both Toxicity Characteristic Leachate Procedure (TCLP) and radionuclide analyses for specified metals and radionuclides shall be performed to verify that the glass meets the NTS WAC. Both of these analyses shall be performed at the existing FEMP laboratory to ensure a turn-around time of less than 28 days, which is the Interim Storage capacity for the FRVP. Approximately 1 to 2 liters of glass shall be required for each sampling event. As a design

Radionuclide emissions, excluding radon and its decay progeny, shall be controlled to ensure that the maximally exposed individual (MEI) member of the public does not receive a total effective dose equivalent in excess of 10 mrem/yr for the airborne pathway in accordance with 40 CFR Part 61, Subpart H requirements (radionuclide NESHAP for DOE facilities). In addition, the exposure to MEI members of the public, as a consequence of all FEMP activities, including the FRVP, shall not exceed 100 mrem/yr for all exposure pathways (DOE Order 5400.5.II.1a). This project shall be assigned 50% of the FEMP's 100 mrem/yr allotment dictated by DOE Order 5400.5.II.1a, but the project design is limited to 4.5 mrem/yr of the 10 mrem/yr NESHAP Subpart H dose limitation.

The radon emissions from activities associated with the FRVP shall be controlled such that the following requirements of DOE Order 5400.5, Chapter IV.6.b and 40 CFR Part 61 Subpart Q are met:

1) The maximum Rn-222 concentration for ambient air at any given point does not exceed 100 pCi/l above background for interim storage of residues.

2) The annual average Rn-222 concentration for ambient air over the facility site does not exceed 30 pCi/l above background for interim storage of residues.

3) The annual average Rn-222 concentration for ambient air at or above any location outside the facility site does not exceed 3 pCi/l above background for interim storage of residues.

4) The average Rn-222 release rate from the material storage area does not exceed 20 pCi/m^2/sec.

5) The management of the stored vitrified material will be performed in accordance with the 40 CFR Part 61 Subpart Q standard for radon. A combination of area monitoring and administrative controls shall be developed to ensure that radon release requirements and worker protection are maintained at ALARA levels.

basis, a sample from each batch shall be required and off-site shipment cannot occur until a non-hazardous determination is made.

The following identifies the packaging and transportation requirements for this waste stream. An exemption from the current regulations for shipments of radioactive material in 49 CFR 173, Subpart I while using regulations proposed in 54 FR 47454 shall serve as the design basis requirements. Under these proposed regulations, the OU4 vitrified material shall be classified as low specific activity, LSA-II, defined as "material in which the activity is distributed throughout and the estimated average specific activity does not exceed 10^{-4} A_2/g for solids." In accordance with this, custom waste packaging containers shall be designed to meet Type A specifications under the proposed regulations for transport to NTS in a side loading, closed transport truck (standard 18-wheeler). The container shall be constructed of steel reinforced concrete with approximate dimensions as follows:

54" (L) x 50" (W) x 53" (H) [internal]
64" (L) x 60" (W) x 63" (H) [external]

The container volume will be 84 ft^3 with a payload capacity estimated at 12,000 pounds and a gross weight of 25,000 pounds. This container information shall be used as the design basis for the FRVP; specifically the glass product handling function design.

Off-gas

All potentially contaminated off-gas from the FRVP during normal operations shall be discharged to the atmosphere either at the New RTS or the vitrification facility. These off-gas streams will contain, and shall be treated for, the following pollutants:

- Rn-222 and other uranium and thorium decay chain radioisotopes
- oxides of nitrogen and sulfur
- metal oxide particulates

Off-gas emissions from the FRVP shall be controlled using Best Available Technology (BAT) per OAC 3745-31-05 (A)(3).

6) Radon released from any project activity will be controlled to not exceed a site boundary concentration of 3 pCi/l as an annual average. This is the DOE Derived Concentration Guide (DCG) in DOE Order 5400.5, Chapter III.

In addition to meeting these ARAR/TBC requirements for Rn-222, DOE has adopted additional controls to ensure on-site and off-site protection during the implementation of this project. Radon released from the vitrification process shall be controlled to not exceed a site boundary concentration of 0.5 pCi/l, above background, as an annual average.

To verify compliance with these regulatory radon limits, radon monitoring at the stack shall be conducted to provide data for air modeling. Existing FEMP fenceline monitors shall also be used to confirm the modeling. In addition, an administrative stack limit of **xxx,xxx pCi/l** will be used as a process control to initiate process correction due to abnormal operating conditions.

Although there are no point source discharge limits per se for SO_x and NO_x that have been established to ensure that the ambient air standards are not exceeded at each point source or in combination with other existing FEMP sources, best available technology (BAT) shall be incorporated in the OTS to control releases of SO_x and NO_x in accordance with OAC 3745-31-05 (A)(3). Refer to Section 1.4.6 for system components.

In addition to the federal requirements, airborne emissions from the FRVP shall be controlled in accordance with identified state requirements. As required by Ohio Administrative Code (OAC) 3745-15-07, sources of air pollutants that present a nuisance or endanger health, safety, or welfare to the public or damage to property shall be prohibited. In addition, visible particulate emissions from stationary sources shall be controlled in accordance with the limits identified in OAC 3745-17-07. Also, fugitive dust emissions generated during construction operations (or other activities that could cause fugitive dust) shall be controlled in accordance with OAC 3745-17-08.

Process Wastewater

Excess process wastewater generated, including Cooling Tower blowdown, during operation of the FRVP shall be transferred to the AWWT prior to discharge to the Great Miami River. This wastewater discharge is regulated under the Federal Clean Water Act and the State of Ohio Water Pollution Control Act.

The process effluent wastewater from the FRVP will be sampled, monitored, and treated at the FRVP, as required, to meet the influent wastewater limits of the AWWT facility. The wastewater acceptance criteria for the AWWT relative to the wastewater expected from the FRVP is as follows:

Radionuclides

TBD

Heavy Metals

TBD

Total Suspended Solids

TBD

All wastewater will then be treated by the AWWT to ensure that the discharge is within the pre-established limits imposed by the sitewide National Pollutant Discharge Elimination System (NPDES) permit, OAC 3745-01 and DOE Order 5400.5.

Stormwater

Appropriate controls shall be designed for the FRVP to mitigate contamination of stormwater runoff in accordance with 40 CFR 122.26 and OAC 3745-38.

The design of the FRVP shall preclude the contact of stormwater with process equipment and the final glass product. Any stormwater runoff that has the potential to be contaminated with hazardous substances shall be segregated, retained, and transferred to the AWWT for treatment. All stormwater treated by the AWWT will be discharged in compliance with the FEMP NPDES permit. Localized stormwater runoff (i.e., area drainage) shall be discharged

to natural on-site drainage courses in accordance with the FEMP NPDES stormwater permit. Refer to Section 2.3.1, Stormwater Management Systems, for additional design requirements.

Sanitary Waste

The sanitary waste system at the FRVP shall be connected to the FEMP sanitary sewer system and treated at the existing FEMP Sewage Treatment Plant.

Solid Waste

The solid waste resulting from this project can be categorized as construction waste, office waste (i.e., paper, boxes, etc.), and process waste (i.e. equipment, spent lubricants, glovebags, PPE, etc.). The design for this project shall limit the generation of solid waste specifically where there is the potential for radiological contamination.

Construction Waste: New construction waste generation during construction of the FRVP shall be managed, segregated as radiologically contaminated or non-contaminated, and dispositioned in accordance with FEMP site construction standards and practices.

Office Waste: Office waste generated during FRVP operation shall be managed and dispositioned in accordance with FEMP site procedure PT-0010, *Collection and Disposal of Controlled Area Office Trash*.

Process Waste: Radiologically contaminated process waste generated during FRVP operations shall be segregated from non-contaminated waste, decontaminated if possible, and dispositioned in accordance with FEMP site procedures. Hazardous wastes shall be segregated from radiologically contaminated waste to eliminate the generation of mixed waste. The design shall consider provisions for equipment cleanout to facilitate decontamination.

Laboratory Waste

Laboratory waste generated at the FRVP shall be managed and dispositioned in accordance with FEMP site standards and procedures. Wastewater from laboratory sinks shall be

transferred for treatment at the AWWT. Laboratory hoods shall be vented to the facility exhaust stack.

Contaminated Soils and Debris

Soil excavation activities during the FRVP shall ensure that fugitive dust emissions are mitigated or eliminated in compliance with OAC 3745-17-08. Management of contaminated soils and debris shall be in accordance with FEMP site procedure EW-0006, *Management of Excess Soil, Debris, and Waste from a Project,* Removal Action No. 17 Work Plan, *Improved Storage of Soil and Debris,* and 40 CFR 264.552.

2.2.4 General Nuclear and System Safety Requirements

The FRVP shall be designed based on the requirements of a Non-Reactor Nuclear Facility (Special Facility) under DOE Order 6430.1A and the facility Hazard Category as determined in accordance with DOE Order 5480.23.

The special facilities (division 13) requirements of DOE 6430.1A apply to the following FRVP functional areas as defined below:

1) Residue Retrieval (Silo 1 or 2) - Liquid Radioactive Waste Facility
2) Residue Retrieval (Silo 3) - Solid Radioactive Waste Facility
3) Feed Preparation and Vitrification - Liquid Radioactive Waste Facility and Solid Radioactive Waste Facility

This project will not be handling, storing, or treating special nuclear materials; therefore, safeguards for these materials are not required.

There is no potential for nuclear criticality because the total concentration of uranium-235 is approximately 256 pCi/g and the minimum level for criticality is 15,000 pCi/g.

The FRVP design shall consider the frequency of occurrence and the effects of Design Basis Accidents (DBAs) established for the FRVP. DBAs for the FRVP shall be based on the Hazard Category determination and the Natural Phenomena Hazard design criteria identified

in Section 2.3.1, Civil and Site Development, and 2.3.2, Structural, of this document. The design basis fire shall be determined in accordance with DOE Order 6430.1A.

Occupational Radiation Protection

Areas in which employees are allowed continuous occupancy shall be designed and controlled to achieve the requirements of 10 CFR 835.1002(b) and (c). To help ensure that radiation exposures are maintained ALARA and in accordance with the DOE Radiological Control Manual (DOE/EH-0256T, Rev. 1, April 94) Article 128.1.a, the individual worker dose shall be ALARA and shall be less than 500 mrem/yr. Shielding shall be provided and designed based on the max expected source term and stay times during normal operations and relative to dose limits. Source terms shall be determined based on Table 2.2-1, Summary of Radionuclide Concentrations in Silos 1 and 2 Residues, and Table 2.2-2, Summary of Radionuclide Concentrations in Silo 3 Residues, extracted from the final RI/FS study for OU4 (February 1994, Volume 2 of 4).

In addition, the FRVP shall be designed to ensure that the routine use of respirators is not required by on-site personnel during normal facility operations.

Where ionizing radiation is present in the process, an area radiation monitoring and alarm system shall be provided to alert personnel of unexpected increases in ionizing radiation levels.

2.2.5 Human Factors

The FRVP design shall consider human factors in accordance with Section 1300-12 of DOE Order 6430.1A.

Table 2.2-1, Summary of Radionuclide Concentrations in Silos 1 and 2 Residues

Analyte[a]	Frequency of Detection[b]	Rejected	Arithmetic Mean[c] (pCi/g)[d]	Upper 95% CI on Mean[c] (pCi/g)[d]	Range of Detects[c] (pCi/g)[d]
SILO 1					
Actinium-227	13/20	0	5960	7670	4320-17390
Lead-210	20/20	0	165000	202000	48980-381400
Polonium-210	13/13	0	242000	281000	144000-434000
Radium-226	20/20	0	391000	477000	89280-890700
Thorium-228	2/20	0	422	2280	835-2280
Thorium-230	24/24	0	60000	68900	10569-105372
Thorium-232	8/20	0	424	1110	661-1106
Uranium-234	21/21	0	800	932	326-1548
Uranium-235/236	14/20	0	38	54	19.1-105
Uranium-238	20/20	0	642	693	387-920
SILO 2					
Actinium-227	11/14	0	5100	6640	2905-10450
Lead-210	14/14	0	145000	190000	58160-399200
Polonium-210	8/8	0	139000	231000	55300-241000
Protactinium-231	1/14	0	2350	4040	4041-4041
Radium-226	14/14	0	195000	263000	657-481000
Thorium-228	5/14	0	645	7360	411-7360
Thorium-230	15/15	0	48400	76200	8365-132800
Thorium-232	3/14	0	402	985	851-985
Uranium-234	13/13	0	961	1160	121-1465
Uranium-235/236	11/13	0	73	94	35.6-172
Uranium-238	14/14	0	912	1120	46-1925

[a]Sample numbers used in this data set include: (Silo 1) 99728, 99743, 99870, 99885, 99909, 99930, 99939, 99948, 99966, 99975, 100004, 100025, 100039, 100108 through 100114; and (Silo 2) 99359, 99710, 99774, 99802, 99811, 99831, 99846, 99861, and 100115 through 100120.
[b]Rejected data not included in total number of samples.
[c]Values qualified with an R are excluded. The mean and upper 95% confidence interval (CI) on mean have been rounded to show three significant figures. The mean is calculated using one-half the Sample Quantitation Limit (SQL) for nondetects.
[d]Values expressed in picoCuries per gram (pCi/g).

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Table 2.2-2, Summary of Radionuclide Concentrations in Silo 3 Residues

Analyte [a]	Frequency of Detection[b]	Rejected	Arithmetic Mean[c] (pCi/g)[d]	Upper 95% CI on Mean[c] (pCi/g)[d]	Range of Detection[c] (pCi/g)[d]
SILO 3					
Actinium-227	9/9	2	618	925	234-1363
Lead-210	11/11	0	2620	3480	454-6427
Protactinium-231	9/11	0	487	627	266-931
Radium-224	11/11	0	290	367	64-453
Radium-226	11/11	0	2970	3870	467-6435
Radium-228	9/11	0	297	406	82-559
Thorium-228	7/11	0	590	747	459-996
Thorium-230	11/11	0	51200	60200	21010-71650
Thorium-232	8/11	0	656	842	411-1451
Uranium-234	11/11	0	1480	1730	348-1935
Uranium-235/236	10/11	0	93.6	117	42-158
Uranium-238	11/11	0	1500	1780	320-2043

[a]Sample numbers used in this data set include: 100097 - 100107.
[b]Rejected data not included in total number of samples.
[c]Values qualified with an R are excluded. The mean and upper 95% CI on mean have been rounded to show three significant figures. The mean is calculated using one-half the SQL for nondetects.
[d]Values expressed in picoCuries per gram (pCi/g).

2.3 Discipline Criteria

2.3.1 Civil and Site Development

Area Subsurface Conditions and Topographic Survey

The results from the topographic survey of the proposed FRVP area shall be utilized for the design (Drawing No. 93X-5900-G-00316, Existing Site Plan, Grid 43).

Subsurface conditions shall be as provided in the geotechnical testing of the FRVP area **(TBD)**.

Siting Factors

No building structures of the FRVP shall be sited in the 100 year flood plain. The siting of the FRVP shall limit the amount of clearing required and impact to other FEMP facilities.

Tie-in points to existing FEMP utilities shall be determined using the latest FEMP Grid/Utility drawings. Routing of underground utilities shall comply with Section 0203-1 of DOE Order 6430.1A.

The acceptability of the facility flooding shall be based on its Hazard Category determination and Table 2.3-1, Summary of Rainfall Event Criteria, below.

Table 2.3-1, Summary of Rainfall Event Criteria

Hazard Category	**General Use**	**Low Hazard**	**Moderate Hazard**	**High Hazard**
	N/A	3	2	1
Performance Category[b]	**PC-1**	**PC-2**	**PC-3**	**PC-4**
Annual Hazard (Rainfall Event) Probability of Exceedance	2×10^{-3}	5×10^{-4}	1×10^{-4}	1×10^{-5}

[a] From Table 6-1 of UCRL 15910 (Ref. 3.2)

[b] Performance Category is based on DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components* (Ref. 3.5)

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Earthwork

Earthwork shall include all grading, excavation, trenching, stockpiling and backfilling and shall be specified to conform to ODOT and OSHA standards, as well as ARAR requirements and FEMP site standards (refer to Section 2.2.3, Contaminated Soils and Debris). Where feasible, final slopes shall be a minimum of 0.5 percent for impervious surfaces, 2 percent for vegetated surfaces, and no greater than 3H:1V unless appropriate erosion controls are provided, i.e., retaining walls.

Temporary and permanent measures to prevent erosion and control sediment during and subsequent to construction shall be specified and designed, including those necessary prior to any earthwork being performed. Erosion controls shall comply with the Standard Construction Drawings (MC-11) and "Construction and Materials Specifications" issued by the ODOT, Bureau of Location and Design.

Fencing

Fencing shall be provided and specified in accordance with Section 0280-1 of DOE Order 6430.1A, as applicable. Temporary fencing shall be specified for use during construction. The integrity of FEMP site perimeter security fencing shall be maintained.

Paving and Surfacing

All paving and surfacing methods, materials, design, and details shall conform to ODOT and AASHTO standards. The AASHTO, *Policy on Geometric Design of Highways and Streets*, 1990 (GDHS-90) shall be used for design. Unless conditions dictate otherwise, the minimum slope shall be 0.50 percent. Typical road cross-slope shall be 2 percent.

Landscaping and Seeding

All areas disturbed during construction of the FRVP that are not designated for surfacing or covering with riprap shall be stabilized with seed or mulch. Supplements to the soil shall be specified, if necessary, for revegetation. Seed and supplement rates and materials shall conform to ODOT standards. Temporary seeding of exposed soil (excluding stockpiles) shall be required per ODOT standards, if the area is not expected to be worked for 30 days.

Water Distribution Systems

Water distribution system design shall comply with Section 0266 of DOE Order 6430.1A, as applicable. All water lines shall have a minimum cover depth of 3.5 feet for frost protection. The layout shall limit the amount of line under pavement. Underground water lines shall maintain 10 feet horizontal separation from sanitary sewer and contaminated process lines. Thrust blocks are required for all lines 2 inches or greater. Gate valves or post indicator valves (PIV) shall be located at line intersections and selected points throughout the distribution system to provide control over the service area.

Potable water distribution systems shall be designed to deliver the peak domestic flow of two and one-half times the average daily demand at a minimum residual pressure of 30 psig at ground elevation. Building service lines shall be a minimum of 1 inch in diameter. American Water Works Association (AWWA) standards for potable water mains and their disinfection shall be followed. Cross-connections between potable and process water or residue lines, as well as sanitary waste drains is prohibited. Refer to Section 2.3.5, Plumbing Systems, for plumbing design requirements.

All water lines supplying fire protection systems and fire hydrants shall be treated as fire mains and designed and installed in accordance with Section 1530 of DOE Order 6430.1A and NFPA 24. Each fire hydrant within the distribution system shall be capable of delivering 1,000 gpm at a residual pressure of not less than 20 psi. Fire hydrant branches (from main to hydrant) shall be at least 6 inches in diameter and no longer than 300 feet. A gate valve shall be installed with each hydrant. Fire hydrants shall be installed at a maximum spacing of 400 feet and shall not be located more than 300 feet from the building, nor closer than 50 feet from the building to be protected. Each building shall be protected by two or more hydrants. Refer to Section 2.3.5, Fire Protection, for additional fire water supply requirements.

Stormwater Management Systems

The design of stormwater management systems shall comply with Section 0270-2 of DOE Order 6430.1A, as applicable. The grading of the FRVP site shall be as such to prevent stormwater run-on to limit the amount of stormwater to be treated due to potential contamination. Soil erosion controls shall be provided.

Storm drainage systems within the catchment of the stormwater management system as well as the stormwater management system itself shall be designed by Soil Conservation Service (SCS) methods. Precipitation values for Hamilton County, Ohio shall be used in the SCS methods (e.g., TR-20, TR-55). Storm drain systems not directly connected to the stormwater management system, with catchments less than 160 acres, shall be designed by the Rational Method. ODOT standards shall be used for Rational Method calculations.

Storm drainage and stormwater management systems shall be designed for the 25-year, 24-hour storm event.

Open channel flow velocities are to be non-erosive and limit sediment accumulation.

Sanitary Wastewater Systems

The sanitary wastewater system design shall comply with Section 0270-1 of DOE Order 6430.1A, as applicable. The sanitary effluent sewer shall be sized, as a minimum, for the maximum number of people expected for one shift. Hydraulic design of sanitary collection systems shall comply with ASCE 37 and Department of the Army TM 5-814-1 and 2. Gravity sewer lines shall be designed with a minimum velocity of the probable maximum daily flow (or full flow, whichever yields a greater slope) of 2.5 feet per second. Wherever feasible, sewers and force mains shall not be routed under buildings or other permanent structures and should be adjacent and parallel to roadways. Wherever feasible, sewers and force mains should have at least 10 feet horizontal separation from potable water lines, otherwise, they shall be encased.

2.3.2 Structural

Structural design shall comply with the requirements of Section 0111 of DOE Order 6430.1A, as applicable and based on the Hazard Category determination and identification of safety class structures, systems, and components (SSCs).

The unit weights of materials and construction assemblies for buildings and other structures used for dead load design shall be those given in ASCE 7-93. When not established by ASCE 7-93, weights shall be determined from data in manufacturers catalogs or drawings.

Live loads for buildings and other structures shall be the maximum loads likely to be produced by the intended use or occupancy, but not less than the minimum uniform or concentrated load stipulated in ASCE 7-93.

Roof live loads shall be as stipulated in ASCE 7-93 and shall include snow loads, snow drifts, or rain loads, whichever produces the more severe effect.

The more stringent of either the UBC or OBBC shall be used to determine the rain and snow loads for the FRVP.

Impact loads shall be determined in accordance with ASCE 7-93.

Combined loads shall be considered per UBC unless otherwise required by DOE Order 6430.1A based on the Hazard Category determination and the identification of safety class items.

Wind load design shall comply with Section 0111-2.4 of DOE Order 6430.1A. The design wind speed shall be 80 mph based on the OBBC. The effective velocity pressure at any height above the ground shall be calculated in accordance with ASCE 7-93. Design wind loads shall be based on factors and coefficients stipulated in ASCE 7-93.

Tornado loadings, tornado missiles, and atmospheric pressure change loads shall be considered, as required, by the NPH Performance Category determination for the FRVP. Tornado design criteria based on recommendations of UCRL 15910 are summarized in Table 2.3-2, Summary of Tornado Design Criteria.

Earthquake load design shall comply with Section 0111-2.7 of DOE Order 6430.1A. The seismic criteria based on UCRL 15910 and site specific data is summarized in Table 2.3-3, Summary of Earthquake Evaluation Guidelines for the FEMP, and 2.3-4, Recommended Damping Values.

Table 2.3-2, Summary of Tornado Design Criteria

Hazard Category[a]	General Use	Low Hazard	Moderate Hazard	High Hazard
	N/A	3	2	1
Performance Category[b]	**PC-1**	**PC-2**	**PC-3**	**PC-4**
Annual Hazard Probability of Exceedance	N/A	N/A	2×10^{-5}	2×10^{-5}
Tornado Wind Speed	N/A	N/A	139 mph	139 mph
Importance Factor[c]	N/A	N/A	1.0	1.35
Atmospheric Pressure Change	N/A	N/A	40 pounds per square foot (psf) at 20 psf/sec	125 psf at 50 psf/sec
Missile Criteria	N/A	N/A	2 x 4 timber plank, 15 lbs. at 100 mph (horizontal); maximum height 150 feet; 70 mph (vertical) 3-in.diameter standard weight steel pipe, 75 lbs. weight at 50 mph (horizontal); maximum height 75 ft. 35 mph (vertical)	2 x 4 timber plank, 15 lbs. at 150 mph (horizontal); maximum height 200 feet: 100 mph (vertical) 3-in.-diameter standard weight steel pipe, 75 lbs. weight at 75 mph (horizontal); maximum height 100 feet. 50 mph (vertical) 3,000-lb.automobile at 25 mph, rolls and tumbles

[a] From Table 5-2 of UCRL 15910 (Ref. 3.2)

[b] Performance Category is based on DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components* (Ref. 3.5)

[c] A determination of the consequence of structure failure

Table 2.3-3, Summary of Earthquake Evaluation Guidelines for the FEMP

Hazard Category	General Use	Low Hazard 3	Moderate Hazard 2	High Hazard 1
Performance Category[b]	**PC-1**	**PC-2**	**PC-3**	**PC-4**
Annual Exceedance Probability	2×10^{-3}	1×10^{-3}	1×10^{-3}	2×10^{-4}
PGA (Peak Ground Acceleration)	$0.10g_a$	$0.13g_a$	$0.13g_a$	$0.20g_a$
Response Spectra	Median amplification (no conservative bias)			
Damping	5%		Post yield	
Analysis Approaches	Static or dynamic force method normalized to code level base shear		Dynamic analysis	
Importance Factor[c]	1.0	1.25	Not used	
Load Factors	Code specified load factors appropriate for structural material		Load factors of unity	
Inelastic Demand-Capacity Ratios	Accounted for by R_w in code base shear equation		F_μ by which elastic seismic response is reduced to account for permissible inelastic behavior	
Material Strength	Minimum specified or known in-situ values			
Structural Capacity	Code ultimate or allowable level		Code ultimate level	
Peer Review, Special Inspection	N/A	Required		

[a] Hazard Category information is taken from Table 5-2 of UCRL 15910 (Ref. 3.2)
[b] Performance Category is based on DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components* (Ref. 3.5)
[c] A determination of the consequence of structure failure

Table 2.3-4, Recommended Damping Values

Type of Structure	Damping (% of Critical)
Equipment and Piping	5
Welded Steel and Prestressed Concrete	7
Bolted Steel and Reinforced Concrete	10
Masonry Shear Walls	12
Wood	15

[a] Corresponding to post-yield stress levels to be used for evaluation of Moderate and High Hazard facilities (from Table 4-6 of UCRL 15910).

The following are specific design requirements for structural materials and design:

1) Concrete: Design shall comply with Section 0300 of DOE Order 6430.1A, as applicable. Minimum concrete strength at 28 days shall be 3,000 psi. Slabs shall have a minimum 28 day strength of 4000 psi. Concrete exposed to weather shall be 4% air entrained.

2) Reinforcement: Deformed billet steel shall conform to ASTM A-615, Grade 60.

3) Grout: High strength, non-shrink grout shall be 1-inch minimum thickness under equipment, columns, and pipe support base plates unless otherwise recommended by equipment supplier.

4) Structural Steel: Design, details, fabrication, and erection of structural steel shall conform to the UBC and the American Institute of Steel Construction (AISC) Manual, 9th edition. The material for structural steel shapes and plates shall conform to ASTM A36. All structural steel and connections, including ladders, handrailing, and grating, shall be painted or

galvanized. Connection bolts shall be high strength ASTM A325 with hardened washer and nut.

5) Field Connections: Connections may be bolted or welded connections per AISC.

6) Operating and Maintenance Platforms: These shall be a minimum of 3 feet wide, with walkways 3 feet minimum width. Handrails and toe plates shall be included in accordance with OSHA requirements.

7) Minimum Headroom Clearance: Clearance shall be 7 feet, 6 inches above nosing line of stairs and shall conform to OSHA requirements.

8) Masonry: Materials, design, and construction of masonry structures shall be per UBC-94, assuming special inspection. Hollow, non-loadbearing block shall be per ASTM C-129. Hollow loadbearing block shall be per ASTM C-90. Mortar shall be per ASTM C-35 or C-56, Type M or N.

9) Open Pipe Trenches: Locate tops of walls at the same elevations as surrounding grades/slabs. Slope trench floors at least 1 percent to drains. Cover with grating weighing not over 150 pounds per piece. Size to allow easy access to in-trench pipe and fittings. Allow 3-inch minimum between flanges or pipe, and walls and floor. Provide anchorage and supports for pipe. Supply reinforced concrete or ductile iron covers if heavy trucks will pass over the trenches.

10) Concrete Slabs-on-Grade: In general, control joints shall be in line with the faces of the foundation pedestals, pilasters, etc., but not over 20 feet apart. Pour strips to be a maximum of 20 feet wide. For equipment and storage areas requiring secondary containment (which shall be unjointed), continuous slab that can be effectively sealed on the surface to prevent leakage or infiltration shall be designed.

11) Foundations: Use spread, mat-type, or continuous strip footings placed in the upper natural soils, or properly compacted fill, for an allowable bearing pressure of x,xxx psf at a

depth of 3 feet below the adjacent final grade. The minimum embedment depth of foundations in soil shall be 3 feet to prevent problems with frost penetration.

Foundations for heavy, vibration producing equipment, i.e., air compressors, diesel generators, etc., shall have separate, isolated foundations.

12) Pre-Engineered Buildings: Pre-engineered buildings shall comply with the MBMA Metal Building Systems Manual.

Factor of Safety Against Overturning

Per UBC Section 1619.1, the base overturning moment for an entire structure, or for any of its individual primary lateral-resisting elements, shall not exceed 2/3 of the dead-load-resisting moment. For an entire structure with a height-to-width ratio of 0.5 or less in the wind direction and a maximum height of 60 feet, the combination of the effects of uplift and overturning shall be reduced by 1/3 (i.e., factor of safety equal to 1.0).

The weight of earth superimposed over footings shall be used to calculate the dead-load-resisting moment. Per Section 1112.1.2 of the OBBC, the overturning moment due to wind load shall not exceed 2/3 of the dead load stabilizing moment unless the building or structure is anchored to resist the excess moment (i.e., factor of safety equal to 1.5).

2.3.3 Architectural

General Criteria

The building(s) of the FRVP shall be designed for a minimum design life of 10 years.

The buildings shall be of the pre-engineered type. The building(s) shall be considered as Factory Occupancy and as Type 2B construction with an approved fire suppression system throughout in accordance with the requirements of UBC, OBBC, and NFPA 13.

The melter/product handling areas shall include process floor drains for equipment washdown collection and transfer to a collection sump for ultimate treatment at the AWWT.

Thermal and moisture protection design shall be in accordance with Division 7 of DOE Order 6430.1A, as applicable.

The specification of surface finishes shall be in accordance with Division 9 of DOE Order 6430.1A, as applicable.

The design and provisions of doors and windows shall be in accordance with Division 8 of DOE Order 6430.1A, as applicable.

The FRVP shall be designed to provide for the estimated number of personnel needed for normal day to day operation as follows:

Operations	17
Non-Operations	6
Maintenance	7

Exits from each occupancy shall lead directly to the exterior of the building and cannot exit through another space or room. Exit doors are required to be a minimum of 3 feet in width and corridors shall have a minimum of 3 feet, 8 inches. Dead end corridors shall not exceed 20 feet in length.

A minimum of two personnel exits are required on all buildings. The maximum length of exit access travel for buildings with a fire suppression system shall be in accordance with NFPA 101. Emergency exits shall be located in accordance with NFPA 101 requirements and shall alarm at the vitrification facility control room when opened. Ceiling and floor finishes at exit access shall be class B (minimum) per NFPA 101.

The design of the building(s) shall consider ease of decontamination where radioactive materials could come into contact. The design of the FRVP shall consider the selection of materials so as to eliminate materials that contain hazardous waste constituents or become a hazardous waste when removed during D&D.

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Materials and Surface Treatment

No new product containing asbestos shall be installed at the FEMP.

The exterior wall covering for all buildings will be 22 gage minimum pre-finished corrugated metal panels.

The roof covering for all buildings will be 24 gage minimum pre-finished corrugated metal panels. The roof classification shall be class B minimum.

Interior walls of support areas shall consist of metal stud framing and gypsum board finish. Exit access corridors shall have 1 hour fire rating; interior wall, ceiling and floor finishes at exit access shall be class B (minimum) per NFPA 101.

Doors in exit access corridors shall be fire rated at 20 minute minimum. All exterior personnel doors, interior doors and fire rated doors shall be hollow metal fabricated from 16 gage sheet steel conforming to ASTM A366. All exterior doors shall be insulated. Hollow metal door frames shall be fabricated from 14 gage sheet steel conforming to ASTM A366. All personnel doors shall have lites with safety glass.

Fire doors and frames shall conform to the requirements of the Underwriters' Laboratories, Inc. for the class of door furnished, and shall carry the Underwriters' label and conform to NFPA 80.

Overhead coiling doors shall be fabricated to resist a wind load of 25 pounds per square foot (psf). Door tracks shall be made of adequate gage and size to meet door size and wind loading. Doors shall be motorized chain hoist operated.

Ceiling finish in the support areas shall be suspended pre-finished fire rated mineral acoustical ceiling panels, NRC range of 0.65 - 0.75 and STC of 40-44, Class A conforming to ASTM E1264 with a 0.25 flame spread rating in accordance ASTM E84.

Ceiling finish in the melter/glass product handling and storage areas shall be exposed structure and fiberglass blanket insulation faced with a vapor barrier. Insulation assembly shall carry Underwriters' Laboratories flame spread rating of 0.25.

Floor finishes in the support areas shall include commercial grade vinyl composition tile floor for locker/toilet areas; commercial sheet vinyl for offices, corridors, and process viewing area. All other areas with concrete exposed floors shall consider the use of an epoxy coating for sealing.

Maintenance coatings shall be durable, abuse resistant and resistant to the high humidity and moisture levels present. Coatings shall be lead and chromate free and have an acceptable volatile organic compound (VOC) concentration.

Compliance with ANSI N512 shall be considered for paint finishes where radiological contamination could occur. Otherwise, painting of surfaces shall be in accordance with the recommendations of the same source manufacturer of the painting system selected. Primers, paints, and finishes shall conform to the standards and other requirements of the same source supplier of the painting system. Typical surfaces to be painted include, but shall not be limited to, the following:

1) Exterior and interior ferrous metals
2) Exterior and interior galvanized metals (touch-up)
3) Exterior and interior concrete masonry units
4) Gypsum wallboard
5) Ferrous piping, ducts, conduits, valves, electrical alarm boxes, pull boxes, cabinets
6) Ferrous pipe and conduit hangers and supports

Stainless steel shall not be painted.

Manufactured items furnished with a factory finish shall also meet the lead, chromate, and VOC requirements.

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Finish hardware for doors shall include butts, locks, kickplates, panic bars, closures, doorstops, thresholds, and silencers.

2.3.4 Mechanical and Process Equipment

This section covers specific criteria for FRVP mechanical and process equipment, i.e., tanks, pumps, melters, etc. All equipment shall be specified as standard equipment unless process requirements dictate otherwise. The following are the minimum criteria that the equipment design shall meet:

General

The ease of decontamination for routine maintenance purposes shall be considered for process equipment in which radioactive materials will come into contact.

Hydraulic hose and fittings used for actuation of lift stations shall comply with the requirements of SAE J516 and SAE J517.

Ball and roller bearings used for material handling equipment shall be rated in accordance with AFBMA 9 and AFBMA 11.

Hoists

Hoists and monorail systems shall be designed in accordance with ANSI MH27.1, NEMA 250, ANSI B30.16, ANSI B30.10, ANSI HST-4M, DOE/ID-10500, and the FEMP Hoisting and Rigging Manual.

Pneumatic Conveying Systems

Dense-phase conveying systems using pressure pots shall be designed in accordance with ASME, Pressure Vessel Code, Section VIII.

Tanks

Confinement systems shall meet the criteria in DOE Order 6430.1A, Paragraph 1300-7 and 1323-5.

Materials shall be selected for corrosion resistance and ease of decontamination.

Storage and transfer systems shall be in accordance with DOE Order 6430.1A, Paragraph 1323-4.3.

Tank design shall meet API 650 and 620.

Silo 3 and Additive material storage bins shall be designed in accordance with ASCE 7-93, DOE Order 6430.1A, and UBC.

Process Pumps

Centrifugal pumps shall meet the criteria outlined in ASME B73.1M.

Heat Exchangers

Heat exchangers shall meet the requirements of applicable sections of TEMA standards.

Pressure Vessels

Pressure vessels shall meet the requirements of the ASME Unified Pressure Vessel Code.

Cooling Towers

Cooling towers shall meet the requirements of DOE Order 6430.1A, Paragraph 1550-2.1.4.

2.3.5 Mechanical Utilities

Heating, Ventilation, and Air Conditioning

The design of the HVAC systems shall conform to Section 1550 of DOE Order 6430.1A, as applicable.

The minimum thermal insulation R values for the process building will be as follows, R=11 for the walls and R=20 for the roof.

Outside design temperature shall be 92°F DB/73°F WB for summer and 1°F for winter.

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The inside temperature in winter in the vitrification area, shall be maintained at 65° F; summer design temperature shall be based on NEMA equipment ratings; no humidity control shall be provided. The process control room design temperature shall be 72°F ± 2°F in winter and summer; the relative humidity shall be maintained between 35-55 percent. Space cooling shall be considered to maintain personnel comfort and equipment protection in the remaining support rooms where the inside temperature shall be maintained at 78°F DB and 50 percent RH in summer and 68°F DB in winter. Where mechanical ventilation cannot maintain the temperature within the NEMA equipment rating, mechanical cooling systems will be provided in compliance with DOE Order 6430.1A, Section 1550-1.5.7.

Ventilation exhaust system design requirements shall be in accordance with DOE Order 6430.1A, Section 1550-1.5. Ventilation air shall be provided to achieve OSHA air quality limits, the Permissible Exposure Limits established by 29 CFR 1910, and ACGIH Threshold Limit Values.

The ventilation system shall diffuse the air adequately so that resuspension of contamination is mitigated. Ventilation exhaust systems will provide a minimum of 6 air changes per hour for the vitrification area.

The ventilation from the vitrification area shall be 100 percent exhausted to meet the requirement of DOE Order 6430.1A, Section 1550-1.5.4 and DE 89-000406.

The ventilation system shall provide airflow from areas of low contamination to areas of higher contamination and shall include backflow protection to prevent cross-contamination. The ventilation system in the vitrification area shall be designed to maintain a negative pressure differential of 0.3 inches of water.

All exhaust shall pass through pre-filters, High Efficiency Particulate Air (HEPA) filters, and an exhaust stack before being discharged to the atmosphere in compliance with DOE Order 6430.1A and ERDA 76-21. Provisions shall be made for in-place DOP testing of the HEPAs in accordance with FEMP site procedure 20-C-707, *DOP Testing of In-Place HEPA Filters.* HEPA filters shall provide a minimum filtration efficiency of 99.97 percent for 0.3-μm

particles. The pressure drop across each filter stage shall be measured. Multiple trains of HEPA filters shall be able to be isolated via leakproof dampers to allow for filter replacement during normal process operations.

Cooling equipment will be sized and selected in accordance with ASHRAE handbooks and shall comply with ARI 520, ARI 550, and ARI 590 in compliance with DOE Order 6430.1A, Section 1550 2.1.

Air-cooled condensers and condensing units shall meet the standards, rating, and testing requirements of ARI 460, ASHRAE Standard 20, DOE Order 6430.1A, Section 1550-2.1.3.

Heating shall be provided by thermostatically controlled electric heating units. Gas or oil fired heating is not permitted.

Design air quantities and transport velocities will be calculated according to the calculation methods prescribed by the ASHRAE System Handbook, the ASHRAE Applications handbook, the ACGIH Industrial Ventilation Manual, 29 CFR 1910, NFPA 45, and ASHRAE Standard 62. Open face fume hoods shall have a minimum average face velocity of 150 fpm.

The exhaust stack shall be at least 12 feet higher than the nearest building within 500 feet (ERDA 76-21 pg. 130). Isokinetic sampling shall be provided in the stack for monitoring radioactive airborne effluents. Refer to Section 2.3.8, Airborne Effluent Monitoring, for specific sampling system design requirements.

All exhaust ductwork, excluding process off-gas piping, shall be designed to maintain a transport velocity of 2500 fpm minimum.

Ductwork that is associated with the process off-gas or that will come into contact with radioactive airborne particles shall be constructed of stainless steel for ease of decontamination. All other ductwork shall be made from galvanized steel.

Plumbing Systems

Plumbing for this facility includes potable water supplies, sanitary drains, and venting systems including fixtures. Plumbing shall comply with DOE Order 6430.1A, Section 1540 , as applicable, and the UPC.

Sanitary vents shall be independent of process vent systems.

Refrigerated drinking fountains shall be provided within the non-controlled areas of the building located to provide for both operations and support personnel.

Emergency eye-wash and showers shall be provided any time a chemical is being used with the possibility of personnel exposure and when its material safety data sheet calls for flushing with water. The eye-wash and showers shall be in compliance with ANSI Z358.1, and shall be located within 100 feet or 10 seconds of travel of the source without changing levels or passing through doors.

Plumbing systems shall drain to the sanitary sewer line.

Process and laboratory waste drains shall be kept separate from the plumbing system drains.

Piping penetration of firewalls shall be sealed to maintain designated fire ratings according to UL 1479.

Heat tracing and insulation shall be required for all piping, fittings, valves, and equipment which are subject to freezing temperatures. Insulation requirements shall be in accordance with ASTM C552, ASTM B209, and ASTM-C533.

Fire Protection

Fire protection design shall comply with Section 0110-6 of DOE Order 6430.1A, as applicable, including water flow and pressure requirements. Automatic sprinkler system selection shall follow the guidance in Section 1530-4 of DOE Order 6430.1A. Halon systems shall not be used at the FEMP.

Fire water supply of these systems shall be provided through connections to the existing FEMP underground system. A looped grid system shall be used, one leg of which shall be from the 8 inch diameter line that services the VPP. Fire water booster pumps shall be used, if determined necessary, to supplement the pressure from the supply header. The following results from the testing of the hydrant (HFH-164) located east of the VPP in line 8 inch FQ1 shall be used as the design basis for supply calculations:

Static Pressure	**xxx psi**
x,xxx gpm	**@ xxx psi**
xx,xxx gpm	**@ xx psi**

Refer to Section 2.3.1, Water Distribution Systems, for additional fire protection water supply requirements.

Electrical and control rooms shall be protected by wet sprinkler systems.

When specified, fire extinguishers shall be adequate for suppression of classes A, B, C, and equipment fires in compliance with NFPA 11, 11A, 12, 15, 16, and 16A.

Fire alarms shall be connected to the FEMP Communication Center (Building 53A) for continuous monitoring, as well as sounding locally. The alarm shall sound in the event that a manual pull station, smoke detector, or sprinkler system is activated. The alarm shall continue to sound until it is locally deactivated.

All fire detection and alarm devices shall have UL-listed components or be FM-approved. Devices and systems shall comply with NFPA 70.

2.3.6 Process Piping

Corrosion and abrasion resistance and ease of decontamination shall be considered when selecting pipe, fittings, and valves. Piping shall be color coded or labeled for identification to comply with ANSI A13.1 and FEMP procedure D10-20-018, *Equipment and Pipe Labeling*.

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Radioactive or other hazardous materials shall be carried in double-walled pipes where the primary pipe leaves a secondary confinement structure. In areas within the secondary confinement structure, the use of double-walled pipe shall be considered. Leakage monitoring shall be provided to detect leakage into the space between the primary and secondary (outer) containment pipe.

The piping system design, welding, and testing shall be in accordance with ASME B31.3, B31.11, the ASME Boiler and Pressure Vessel Code, ASNT-SNT-TC-1A, and AWS D1.1.

Heat tracing and insulation shall be required for all piping, fittings, valves, and equipment which are subject to freezing temperatures. Insulation requirements shall be in accordance with ASTM C552, ASTM B209, and ASTM-C533.

Pipe hangers and supports shall be designed and spaced in accordance with MSS SP-58 and SP-69. Auxiliary steel supports shall be in accordance with ASTM A-36 and A-576.

Piping penetration of firewalls shall be sealed to maintain designated fire ratings according to UL 1479.

Slurry carrying pipes shall have removable long radius elbows to facilitate the clearing of pipeline backups. Slurry carrying pipes shall be provided with flushout capability.

Provisions shall be made so that liquids can be sampled, as required, to maintain and monitor the process.

Pneumatic conveying piping shall be vacuum tested in accordance with ANSI B30.1

2.3.7 Electrical

Basic Electrical Materials and Methods

Electrical design shall comply with Section 1605 of DOE Order 6430.1A, as applicable. No products containing polychlorinated biphenyls (PCBs) shall be installed at the FEMP.

Only copper conductors shall be used in buildings and in underground wiring in accordance with FEMP practice. Stranded wire is preferred for all wire sizes.

All energy isolation points shall be capable of accepting a lock without the use of any extra or special devices.

Exterior and Interior Electrical Service Requirements

The design shall comply with the exterior and interior electrical service requirements of Sections 1630 and 1640 of DOE Order 6430.1A, as applicable. An overall power factor for the FRVP of not less than 90% shall be maintained to prevent utility company penalties. Lightning protection for the facility shall be considered using Appendix I Assessment Guide in NFPA 780 (formerly NFPA 78). Exterior aerial circuits, both power and fire alarm, evacuation, communications, and other related signals, shall have surge protectors on both ends of the circuit.

Power Supply

Electrical power for the FRVP shall be served from the existing FEMP 13.2 kV distribution system. Each electrical substation used for power distribution to the FRVP shall be served by a primary 13.2 kV feed and an alternate 13.2 kV feed.

Standby Power

A standby diesel generator(s) shall be used for back-up power on loads in which the FEMP dual primary circuits (normal, alternate) are not considered adequate redundancy (see Section 1630-1.3 of DOE Order 6430.1A) or where emergency power systems are not required per 6430.1A, Section 1660. The generator shall be automatic starting upon loss of power. In addition, UPS(s) shall be provided for the DCS and any other equipment or systems requiring short term, uninterruptible power.

Radiation monitoring and alarm systems that are required during a loss of normal power shall be provided with an uninterruptible power supply unless they can tolerate a temporary loss of function without losing needed data and they are provided with standby power.

Grounding

Grounding shall conform to DOE Order 6430.1A, Section 1639, as applicable.

Exterior Lighting

Exterior lighting shall comply with Section 1650 of DOE Order 6430.1A, as applicable. Exterior lighting ballasts shall be 480 V except for building-mounted fixtures which shall use building low voltage power (120 V, 208 V, or 240 V, as applicable). Photoelectric cells shall be provided to turn off exterior lighting when it is not required. High pressure sodium fixtures shall be used.

Interior Lighting

Interior lighting, including exit and emergency lighting systems, shall comply with Section 1655 of DOE Order 6430.1A, as applicable. Interior lighting shall use fluorescent and high-pressure sodium fixtures.

Exterior and Interior Communications Systems

Exterior and interior communications and alarm systems shall be provided in compliance with Section 1670 and 1671 of DOE Order 6430.1A, as applicable.

The FRVP shall include loud speakers and be tied into the FEMP Emergency Message System to receive plant-wide alarms and announcements. The speakers shall be of adequate number and location to ensure the notification of all FRVP personnel during normal operations.

A telephone system shall be provided for the FRVP to integrate with the existing FEMP system. Telephone specifications shall comply with FEMP site practices. Exterior FEMP access shall only be provided in non-process areas so as not to interfere with operations. Computer hookups shall be included in the support offices and process control room.

2.3.8 Instrumentation and Controls

Distributed Control System (DCS)

The DCS shall be a special-purpose, functionally distributed, microprocessor-based system with hierarchical functions supervised or handled by a host computer. The microprocessor distributed controllers shall perform routine process control functions, various interlock and logic routines, and sequential operations. The microprocessor software shall be preprogrammed to allow the user selection of desired functions and ranges and graphic displays of the process and alarms without required knowledge of computer programming. Standard vendor-supplied software shall be capable of calling up real-time displays and historical trends. The distributed microprocessors shall have execution speeds, scan rates, transmission rates and loadings appropriate to ensure control of the facility or process.

Most functions required to operate the plant, or sections of the plant, shall be accessible directly from graphic displays of the process at central consoles. These consoles shall include start-stop switches, alarms, and DCS displays. Each control room console shall be capable of displaying dynamic or historical process, or facility data and graphics. Printer(s)/plotter(s) shall be provided for hard copy output.

Software and components shall be a modular design which may be easily upgraded as enhanced hardware and software becomes available over the system lifetime.

As much as practicable, DCS equipment shall be located away from heat, chemical contamination, and radioactive zones. Instrument enclosures shall be suitably designed for the operating environment. The DCS shall have self diagnostics for microprocessor controlled instrument loop failures.

Instruments of modular design shall be used to facilitate replacement, without in-place diagnosis and repair. Instruments shall be designed and located to facilitate calibration in testing. Panel-mounting instruments shall be removable from the panel without disturbing exterior connections. The DCS shall be provided with UPS power.

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The DCS shall be capable of password or keylock security to prevent unauthorized user override of safe limits or unapproved reprogramming while providing access to a small number of authorized users.

The installed spare capacity of system hardware such as input, output, memory, peripheral, and additional DCS devices shall be a minimum of 25 percent.

Alarms and off-limit conditions shall be processed in a hierarchical manner to permit the operator to concentrate on the most important conditions first and to easily trace down the source of a problem.

The DCS availability shall be at least 99 percent for real-time functions. Data handling functions shall have system availability of at least 96 percent, but system architecture shall be such that there is not significant loss of data on component failure. Failure is defined as loss of function that cannot be substituted for by the remaining components of the system. That is, loss of a nonredundant I/O card is a failure, but loss of one monitor on a multiple monitor console is not a failure. No single failure of the DCS shall exceed the single failure criteria specified in this document. No single failure shall prevent safe shutdown of the FRVP or individual processes. Where survival of vital controls and alarms cannot be ensured, separate backup controls and fail-safe features shall be provided.

The FEMP central computer system shall be considered to perform the management information functions, i.e., database management, DCS support, interface function. Otherwise, a dedicated system shall be specified.

Controls

Controls shall be in accordance with Section 1595 of DOE Order 6430.1A, as applicable.

Instrumentation

Electrical process instruments shall be preferred over pneumatic instruments. The choice of instruments shall depend on range, accuracy, and compatibility with safety, reliability, and

maintainability. Instrument signals shall use standard voltages or currents. Electronic instruments shall be FM approved or UL listed.

Airborne Effluent Monitoring

The airborne effluent monitoring systems for the FRVP off-gas shall be designed in accordance with the applicable requirements identified in DOE Order 5400.1, DOE Order 5400.5, DOE Order 6430.1A (Section 1589-99), the DOE Environmental Regulatory Guide for Radiological Environmental Monitoring and Environmental Surveillance (DOE/EH-0173T), the Guide to Sampling Airborne Radioactivity in Nuclear Facilities (ANSI N13.1-1969), and 40 CFR 61, Subpart H. The design specifications for these systems (e.g., types of detectors, monitors, and samplers; system redundancy; standby/backup power supplies; alarms; isokinetic sampling; etc.) shall be commensurate with the magnitude of (1) the design basis effluent source term that could be potentially released during normal and postulated accident conditions, and (2) the associated impacts to the occupational worker and the public. Continuous effluent monitoring systems shall include strip chart recording to supplement record keeping.

APPENDIX A

Summary of ARARs and TBCs with Strategies for Compliance

APPENDIX A

Summary of Applicable or Relevant and Appropriate Requirements (ARARs), and To Be Considered (TBC) Criteria for the FRVP Project

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Ohio Water Quality Standards	3745-1-07 Use Designations and Criteria All pollutants or combinations of pollutants shall not exceed, outside the mixing zone, the Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designations listed in Tables 7-1 through 7-15 of this rule. The following constituents of concern (COCs) for Operable Unit 4 have warm water habitat maximum concentration levels outside the mixing zone as follows: Constituent — Criteria conc.[a] (ug/L) — 30-day average conc. (ug/L) Antimony — 650 — 190 Arsenic — 360 — 190 Beryllium — Tab. 7-10[b] — Tab. 7-11[c] Cadmium — Tab. 7-10 — Tab. 7-11 Chromium — Tab. 7-10 — Tab. 7-11 Copper — Tab. 7-10 — Tab. 7-11 Cyanide — 46 — 12 Lead — Tab. 7-10 — Tab. 7-11 Mercury — 1.1 — 0.20 Nickel — Tab. 7-10 — Tab. 7-11 Selenium — 20 — 5.0 Silver — Tab. 7-10 — 1.3 Thallium — 71 — 16 Zinc — Tab. 7-10 — Tab. 7-11 2-Butanone — 160,000 — 7,100 4-Nitrophenol — 790 — 35 Acetone — 550,000 — 78,000 Aldrin — ---- — 0.01 Bis(2-ethylhexyl)phthalate — 1,100 — 8.4 Carbon tetrachloride — 1,800 — 280 (CONTINUED ON NEXT PAGE)	Applicable	Paddys Run and the stream segment of the Great Miami River adjacent to the FEMP are designated as warm water aquatic life habitats with use designations of agricultural and industrial water supply, and primary contact recreation. OAC 3745-1-21 establishes the classification of the receiving waters for the FEMP. Wastewater generated at the FRVP will be pretreated (if required) and discharged to the existing FEMP Advanced Wastewater Treatment (AWWT) System prior to discharge to the Great Miami River. Treatment will be in accordance with FEMP NPDES permit limits and conditions or applicable Water Quality Standards. Stormwater discharges associated with the construction and operation of the FRVP will be managed in accordance with 40 CFR 122.26 and OAC 3745-38. Existing site protocols and procedures related to stormwater management will be extended to the construction and operation of this facility.

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Chemical, Location, or Action	Requirement			ARAR/TBC	Strategy for Compliance
Ohio Water Quality Standards (cont.)	DDT	----	0.001		
	Dieldrin	----	0.005		
	Di-n-butylphthalate	350	190		
	Diethylphthalate	2,600	120		
	Dimethylphthalate	1,700	73		
	Endosulfan[d]	----	0.003		
	Endrin	----	0.002		
	Fluoranthene	200	8.9		
	Methylene chloride	9,700	430		
	PCBs	----	0.001		
	Phenol	5,300	370		
	Tetrachloroethene	540	73		
	Toluene	2,400	1,700		
	[a] Criteria concentration shall be met outside mixing zone. [b] Criteria concentration based on hardness of water. See Table 7-10 for calculation to determine maximum concentration outside the mixing zone. [c] 30-day average criteria based on hardness of water. See Table 7-11 for calculation to determine allowable 30-day average concentration outside the mixing zone. [d] No designation was made as to whether endosulfan referred to endosulfan I or endosulfan II or the sum total of both. The remaining COCs for OU4 will have criteria concentration levels based on calculated acute aquatic criteria (AAC) or chronic aquatic criteria (CAC).				

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Inorganic Chemicals in Drinking Water	40 CFR § 141.11, 141.15, 141.16, 141.51, 141.62, and 143.3 (OAC 3745-81-11, 3745-81-15, and 3745-81-16) The following maximum contaminant levels (MCLs) for inorganic chemicals are the maximum permissible levels of a contaminant in water which is delivered to a free flowing outlet to the ultimate user of a public water system: Inorganic Chemicals — Federal MCL (mg/L) — State MCL (mg/L) — Federal MCLG (mg/L) Antimony — 0.006[2] Arsenic — 0.05[1] Barium — 2.0[2] Beryllium — 0.004[2] Cadmium — 0.005[2] Chromium — 0.1[2] Copper — — — 1.3[9] Cyanide — 0.2[2] Lead — 0.015[9] Manganese — 0.05[6] Mercury — 0.002[2] Nickel — 0.1[2] Selenium — 0.05[2] Silver — 0.1[6] Thallium — — — 0.0005[3] Beta particle & Photon activity — 4 mrem[5] (Excluding radium & uranium) Gross alpha particle Activity — 15 pCi/L[4] (Excluding radon & uranium) Ra-226 — 20 pCi/L* — 5 pCi/L (Ra-226 & Ra-228)[7] Ra-228 — 20 pCi/L* Rn-222 — 300 pCi/L* Uranium — 20 ug/L* (30 pCi/L) Strontium-90 — 8 pCi/L — 8 pCi/L[8] Zinc — 5.0[6] * Proposed standards in the table are to be considered (TBC) criteria [1] 40 CFR 141.11 [5] 40 CFR 141.16 [2] 40 CFR 141.62 [6] 40 CFR 143.3 The federal secondary MCL found in this site, like [3] 40 CFR 141.51 the Ohio secondary MCL, is not enforceable [4] 40 CFR 141.15 [7] OAC 3745-81-15 [8] OAC 3745-81-16 [9] This standard is technically an action level rather than a true MCL or MCLG. The lead action level is more stringent than the MCL at 0.05 mg/L; the copper action level is enforceable. This reference is found in 40 CFR 141.80 (56 FR 26549).	Relevant and Appropriate	Design of the on-site FEMP disposal cell will be developed under the scope of OU2. Design will include controls to prevent contamination of drinking water supply.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Organic Chemicals in Drinking Water	40 CFR § 141.61 (OAC 3745-81-12) The following MCLs for organic chemicals are the maximum permissible levels of a contaminant in water which is delivered to a free flowing outlet of the ultimate user of a public water system: Organic Chemicals — Federal MCLs (mg/L) — State MCLs (mg/L) Benzo(a)pyrene — 0.0002 Bis(2-ethylhexyl)phthalate — 0.006 Carbon tetrachloride — 0.005 Endrin — 0.0002 Heptachlor epoxide — 0.0002 Polychlorinated biphenyls — 0.0005 Toluene — 1.0 Xylenes — 10.0	Relevant and Appropriate	Design of the on-site FEMP disposal cell will be developed under the scope of OU2. Design will include controls to prevent contamination of drinking water supply.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Chemicals in Drinking Water (Solid Waste Disposal Facility)	40 CFR § 257.3-4 [OAC 3745-27-10(D)] A solid waste disposal facility shall not contaminate an underground drinking water source beyond the solid waste boundary (outermost perimeter of the waste). The concentration of chemicals shall not exceed background levels or listed MCLs, whichever is higher. Inorganic Chemicals — RCRA MCLs (mg/L) Arsenic 0.05 Barium 1.00 Cadmium 0.01 Chromium 0.05 Lead 0.05 Mercury 0.002 Selenium 0.01 Silver 0.05 Organic Chemicals & Radionuclides — RCRA MCLs (mg/L) Endrin 0.0002 Combined Ra-226 and Ra-228 5 pCi/L Gross alpha particle activity, excluding radon and uranium 15 pCi/L	Relevant and Appropriate	Design of the on-site FEMP disposal cell will be developed under the scope of OU2. Design will include controls to prevent contamination of drinking water supply.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Chemicals in Drinking Water (Hazardous Waste Disposal Facility)	40 CFR § 264.94 (OAC 3745-54-94) A hazardous waste disposal facility must comply with the requirements specified in the facility permit for the uppermost aquifer underlying the waste management area beyond the point of compliance, which is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated area. The concentration of chemicals in groundwater shall not exceed background levels or the listed maximum concentration (MC) of the constituent for groundwater protection, whichever is greater. Chemical — RCRA MC (mg/L) Arsenic — 0.05 Barium — 1.00 Cadmium — 0.01 Chromium — 0.05 Lead — 0.05 Mercury — 0.002 Selenium — 0.01 Silver — 0.05 Endrin — 0.0002	Relevant and Appropriate	Design of the on-site FEMP disposal cell will be developed under the scope of OU2. Design will include controls to prevent contamination of drinking water supply.
Ohio Water Quality Standards	OAC 3745-1-04 The following general water quality criteria apply to both discharges to surface waters as a result of remediation and on-site surface waters potentially affected by project activities. All surface waters of the state shall be free from: • objectionable suspended solids • floating debris, oil and scum • materials that create a nuisance • toxic, harmful or lethal substances • nutrients that create nuisance growth	Relevant and Appropriate	Wastewater produced at the FRVP will be pretreated, if necessary, monitored, and discharged to the FEMP AWWT system for final treatment to comply with these aquatic quality criteria.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Protection of the Public and the Environment	DOE Order 5400.5 Chapter III Residual concentrations of radionuclides in water that may be ingested are listed below. These derived concentration guides (DCGs) for the COCs are based on a committed effective dose equivalent (CEDE) of 100 mrem/yr, assuming ingestion of 2 liters/day. Note that these DCGs apply <u>only if</u> ingestion is the single pathway of exposure. Isotope — Ingested Water (uCi/mL) Actinium-227 — 1×10^{-8} Lead-210 — 3×10^{-8} Polonium-210 — 8×10^{-8} Protactinium-231 — 1×10^{-8} Radium-224 — 4×10^{-7} Radium-226 — 1×10^{-7} Radium-228 — 1×10^{-7} Technetium-99 — 1×10^{-4} Strontium-90[c] — 1×10^{-6} Thorium-228 — 4×10^{-7} Thorium-230 — 3×10^{-7} Thorium-232 — 5×10^{-8} Uranium-234 — 5×10^{-7} Uranium-235 — 6×10^{-7} Uranium-236 — 5×10^{-7} Uranium-238 — 6×10^{-7}	To Be Considered	Remediation of OU4 waste has the potential to release radionuclides that are contained in the waste materials to environmental media. Although activities anticipated by this project will take place over the Great Miami aquifer, which is used as a source of drinking water, the design, which includes stormwater run-on/run-off control, tank secondary containment, and the use of the K-65 underdrain system, shall minimize the potential for the release of radionuclides to soil or groundwater. Wastewater generated at the FRVP will be pretreated and discharged to the existing FEMP AWWT treatment system. Treatment will ensure that the discharges do not violate FEMP NPDES permit limits and conditions or applicable Water Quality Standards.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Protection of the Public and the Environment	DOE Order 5400.5 Chap. III Residual concentrations of radionuclides in air in uncontrolled areas are limited to the following. (For known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding limit must not exceed 1.0.) Derived Concentration Guide[a] (uCi/mL) Isotope / D / W / Y Actinium-227: 2×10^{-15} / 7×10^{-15} / 1×10^{-14} Lead-210: 9×10^{-13} / ------[b] / ------ Polonium-210: 1×10^{-12} / 1×10^{-12} / ------ Protactinium-231: ------ / 9×10^{-15} / 1×10^{-14} Radium-224: ------ / 4×10^{-12} / ------ Radium-226: ------ / 1×10^{-12} / ------ Radium-228: ------ / 3×10^{-12} / ------ Technetium-99: 1×10^{-8} / 2×10^{-9} / ------ Strontium-90[c]: 5×10^{-11} / ------ / 9×10^{-12} Thorium-228: ------ / 5×10^{-14} / 4×10^{-14} Thorium-230: ------ / 4×10^{-14} / 5×10^{-14} Thorium-232: ------ / 7×10^{-15} / 1×10^{-14} Uranium-234: 4×10^{-12} / 2×10^{-12} / 9×10^{-14} Uranium-235: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-236: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-238: 5×10^{-12} / 2×10^{-12} / 1×10^{-14} [a] D, W, and Y (Days, Weeks, and Years) represent lung retention classes; removal halftimes assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 8,400 m^3 of air per year (based on an exposure over 24 hours per day, 365 days per year). [b] A hyphen means no limit has been established. [c] The value shown for daily DCG is for strontium radionuclides with a f_1 value of 3×10^{-1}. The value shown for yearly DCG is for strontium radionuclides for a f_1 value of 1×10^{-2}.	To Be Considered	Operation of the OU4 FRVP has the potential to release radionuclides that are contained in the waste materials. The facility design will include HEPA filtration to control radionuclide and particulate emissions where appropriate. Monitoring of radionuclide emissions from the FRVP will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code. A continuous isokinetic sampler will be used at the exhaust stack. Release of radon will be mitigated by use of carbon adsorption beds. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through established construction practices.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Residual Radioactive Material	DOE Order 5400.5 Chap. IV, 6.b Interim Storage: The above-background concentration of radon-222 in air above an interim storage facility must not exceed 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 3 pCi/L at or above any location outside the site.	To Be Considered	Management of radium bearing waste could result in the release of radon gas to the environment. Removal of radium bearing waste and storage prior to vitrification will include controls designed to mitigate release of radon. During operation of the FRVP, the facility off-gas treatment system will provide adequate radon controls. These requirements will be met for interim storage of the vitrified product due to the low surface release rates of radon gas from the vitrified product. Radon monitoring will be conducted as necessary to demonstrate compliance with these release limits.
Radionuclide Emissions (Except Airborne Radon-222)	40 CFR 61, Subpart H Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that will cause any member of the public to receive in any year an effective dose equivalent of 10 mrem per year. Monitoring is required at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% (0.1 mrem/yr) of the standard .	Applicable	The pollution control equipment for the silos and vitrification off-gas emissions will be designed to limit the discharge of radionuclides to acceptable levels. The facility design will include HEPA filters to minimize particulate emissions. Monitoring of radionuclide emissions from the FRVP will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through good construction practices.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radon-222 Emissions	40 CFR 61, Subpart Q No source at a DOE facility shall emit more than 20 pCi/m^2-s of radon-222 as an average for the entire source during periods of storage and disposal.	Applicable	While this requirement is neither applicable nor relevant and appropriate to treatment operations, it is applicable to storage of waste material in Silos 1 and 2 prior to treatment, and storage of vitrified product following treatment. Although applicable to the silos, USEPA and DOE entered into a Federal Facilities Agreement (FFA) on November 14, 1991. In accordance with the terms of the FFA, demonstration of compliance with 40 CFR § 61 Subpart Q at the silos is not required prior to remediation; however, compliance must be demonstrated when final remediation of OU4 is complete. Design of the waste removal system, along with appropriate procedures, controls, and monitoring, will mitigate radon releases during the material removal phase. This requirement will be met for interim storage of the vitrified product due to the low surface release rates of the radon gas from the vitrified product. Radon monitoring will be conducted as necessary to demonstrate compliance with this requirement.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Standards for Control of Residual Radioactive Material	40 CFR § 192.02(b) Establishes standards for managing residual radioactive material from inactive uranium processing sites so the average release rate of radon-222 does not exceed 20 pCi/m^2-s or the average concentration in air outside the facility boundary does not exceed 0.5 pCi/L above background following remediation activities.	Relevant and Appropriate	Vitrified material will be shipped off-site for proper disposal at the NTS. Decontamination, demolition, and disposition of vitrification plant and storage silos will be in accordance with strategies and methodologies consistent with the OU3 ROD and the Removal Action 17 Work Plan. Contaminated soils will be excavated and managed in accordance with strategies and methodologies consistent with the OU5 ROD and the Removal Action 17 Work Plan.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Solid, Nonhazardous Waste Disposal Facility Design Considerations	OAC 3745-27-07(B) Information required by a Permit-to-Install shall address the following location requirements: OAC 3745-27-07(B)(1)(2)(3) Is not located in a sand or gravel pit where the sand or gravel has not been completely removed, a limestone quarry or a sandstone quarry, national or state park, or candidate for potential inclusion in the national park system. OAC 3745-27-07(B)(4) Is not located within the surface and subsurface area(s) surrounding a public water supply well through which contaminants might move toward and might reach the public water supply well within a period of 5 years. OAC 3745-27-07(B)(5) Construction of an on-property solid waste disposal facility must meet the location criteria as set forth in this rule. Prohibits siting landfills over sole source aquifers. OAC 3745-27-07(6) The limits of solid waste placement are not located within 1000 feet of an area designated as either a state resource water, coldwater habitat, or an exceptional warmwater habitat. OAC 3745-27-07(B)(7) The limits of solid waste placement and the leachate management system are not located within 200 feet of a fault that has displacement in Holocene time. OAC 3745-27-07(B)(8) The sanitary landfill facility is not located within an area of potential subsidence due to an underground mine. OAC 3745-27-07(B)(9) The sanitary landfill facility is not located above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24-hour period to a water supply well located within 1000 feet of the limits of solid waste placement. OAC 3745-27-07(B)(10) The limits of solid waste placement and the leachate management system are not located in a regulatory floodplain. OAC 3745-27-07(B)(11) The limits of the solid waste placement are not located within 1000 feet of a water supply well or a developed spring.	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Solid, Nonhazardous Waste Disposal Facility Design Considerations (cont'd)	OAC 3745-27-07(B)(12) The limits of solid waste placement are not located within 300 feet of the sanitary landfill facility's property line. OAC 3745-27-07(B)(13) The limits of solid waste placement are not located within 1000 feet of a domicile whose owner has not consented in writing to the location of the sanitary landfill facility. OAC 3745-27-07(B)(14) The limits of solid waste placement are not located within 200 feet of a stream, lake, or natural wetland. OAC 3745-27-07(B)(15) The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill facility is not less than 15 feet of in situ or added geologic material.		
Protection of Wetlands (Solid Waste Disposal Facility)	40 CFR § 258.12 New municipal solid waste landfill units must not be located in wetlands unless the State approves otherwise.	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.
Endangered Species Protection	50 CFR § 402 (OAC 1518, 1513.25, and 1501-18-1-01) Remedial actions must not jeopardize the continued existence of any endangered or threatened species, or potential habitat of threatened or endangered species.	Relevant and Appropriate	No endangered species have been identified in Operable Unit 4. The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Compliance with Floodplain/Wetlands Environmental Review Requirements	10 CFR 1022 (Executive Order 11990) DOE actions in a floodplain or wetland must first evaluate the potential adverse effects those actions might have on the floodplain or wetland, and consider the natural and beneficial values served by the wetlands.	Applicable	The proposed action has the potential to destroy or modify FEMP site wetland areas. Potential impacts are identified during preparation of NEPA documentation for this activity. NEPA documentation will also specify public notice requirements, wetland assessments, and any mitigative measures that may be required. The design shall minimize any impact on wetlands and will not be located in any floodplain.
Nationwide Permit Program	33 CFR 330 The discharge of dredged or fill material into wetlands or waters of the U.S. must be conducted in compliance with the terms and conditions of the U.S. Army Corps of Engineers' (ACOE) Nationwide Permits (NWPs) as promulgated in 33 CFR 330 Appendix A.	Applicable	Construction of the FRVP could result in minor wetland disturbances. All dredge and fill activities related to construction of access roads and utility lines will be conducted in accordance with the substantive terms and conditions of Nationwide Permit 12 - Utility Line Backfill and Bedding. The OEPA has been granted Section 401 State Water Quality Certification for NWP 12.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Discharge of Storm Water Runoff	40 CFR 122.26 (OAC 3745-38) Storm water discharge associated with construction sites and industrial activities must be monitored and controlled. A Stormwater Pollution Prevention Plan (SWPPP) is required for construction activities which result in a total land disturbance of 5 or more acres.	Applicable	Industrial stormwater discharges associated with the FRVP are covered by the FEMP NPDES Stormwater Permit Application submitted to OEPA in September, 1992. A sitewide Stormwater Pollution Prevention Plan (SWPPP) is being prepared pursuant to this application. Construction associated with the FRVP will utilize appropriate controls to ensure contamination of stormwater is limited. Outside pads (not under roof) will have berms or curbs to contain runoff, and to prevent run on. Collected stormwater will be discharged through the existing site stormwater discharge system or AWWT, as required.
Discharge of Treatment System Effluent	40 CFR 125.100 <u>Best Management Practices</u> Develop and implement a Best Management Practices (BMP) program to prevent the release of toxic or hazardous constituents to waters of the U.S. Development and implementation of a sitewide BMP program is also required as a condition of the FEMP NPDES Permit. 40 CFR 125.104 The BMP program must: • Establish specific procedures for the control of toxic and hazardous pollutant spills and runoff. • Include a prediction of direction, rate of flow, and total quantity of toxic and hazardous pollutants where experience indicates a reasonable potential for equipment failure.	Relevant and Appropriate	Construction associated with the FRVP will utilize appropriate controls to ensure contamination of stormwater is limited. Outside pads (not under roof) will have berms and curbs to contain run-off, and to prevent run-on. Collected stormwater will be discharged through the existing site stormwater discharge system or AWWT, as required. In addition, secondary containment will be used around tanks to control potential spills.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
On-Site Nonhazardous Waste Management Facilities (Design Standards)	40 CFR § 241 Subpart B (OAC 3745-27-08) Establishes design criteria for the proposed disposal facility for Subunit C material.	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.
Hazardous Waste Determinations	40 CFR 262.11 OAC 3745-52-11 Any generator, who treats, stores, or disposes of solid wastes, must determine whether or not the waste is hazardous. The procedures to be followed include: • To identify whether a particular material of concern is a "solid waste" • To identify whether a particular exclusion applies to the material eliminating it from definition as a "solid waste" • To identify whether a particular solid waste might be classified as a hazardous waste • To determine if a material, otherwise classified as a "hazardous waste" might be excluded from RCRA regulation	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes).	These procedures are established to determine whether wastes are subject to the requirements of RCRA. The residues in Silos 1, 2, and 3 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to determine whether OU4 wastes, whether excluded or not, are similar to hazardous wastes based on the TCLP results. To ensure protectiveness, wastes sufficiently similar to hazardous waste will be treated, stored, and disposed in accordance with RCRA requirements. Other wastes, such as those generated during construction and operation of the FRVP, will also require testing or process knowledge to determine proper management and disposal requirements. Characterization of waste generated during construction projects, including soil, will be performed in accordance with site procedure EW-0006, "Management of Excess Soil, Debris, and Waste from a Project". All other waste characterization will be performed in accordance with site procedure EW-0001, "Initiating Waste Characterization Activities Using the Material Evaluation Form".

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Empty Containers	40 CFR 261.7 OAC 3745-51-07 Containers that have held hazardous wastes are "empty" and exempt from further RCRA regulations if: • no more than 2.5 cm (one inch) of residue remains on bottom of inner liner; or • the remaining residue is less than 3% by weight of the total capacity, for containers whose total capacity is less than or equal to 110 gallons, or • the remaining residue is less than 0.3% by weight of the total capacity, for containers whose total capacity is greater than 110 gallons.	Relevant and Appropriate	Containers and tanks used to store waste from Silos 1, 2, and 3 might contain residues that exhibit hazardous waste characteristics which must be removed before the container might be reused or disposed. Removed material, if sufficiently similar to hazardous waste, will be managed in accordance with appropriate regulatory requirements.
Generators Who Transport Hazardous Waste for Off-Site Treatment, Storage, or Disposal	40 CFR § 262.20 - 262.33 and 263.20 - 263.31 (OAC 3745-52-20 - 3745-52-33 and 3745-53-20 - 3745-53-31) Any generator who transports hazardous waste for off-site treatment, storage, or disposal must originate and follow-up the manifest for off-site shipments.	Applicable	Waste generated during remedial activities that is determined to be hazardous will be transported in accordance with this requirement.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Standards	40 CFR 264, Subpart B, General Standards OAC 3745-54-13 through 16 1) Waste Analysis (OAC 3745-54-13)-Operators of a facility must obtain a detailed chemical and physical analysis of a representative sample of each hazardous waste to be treated, stored, or disposed of at the facility prior to treatment, storage, or disposal. 2) Security (OAC 3745-54-14)-Operators of a facility must prevent the unknowing or unauthorized entry of persons or livestock into the active portions of the facility, maintain a 24-hour surveillance system, or surround the facility with a controlled access barrier and maintain appropriate warning signs at facility approaches. 3) Inspections (OAC 3745-54-15)-Operators of a facility must develop a schedule and regularly inspect monitoring equipment, safety and emergency equipment, security devices and operating and structural equipment that are important to preventing, detecting or responding to environmental or human health hazards, promptly or immediately or immediately remedy defects, and maintain an inspection log. 4) Training (OAC 3745-54-16)-Operators must train personnel within 6 months of their assumption of duties at a facility in hazardous waste management procedures relevant to their position including emergency response training.	Relevant and Appropriate	Areas and activities of this project which could contain or generate hazardous waste or waste sufficiently similar to RCRA hazardous waste must comply with these RCRA requirements. 1) Sampling and analysis plans will be developed in support of the OU4 RD/RA activities. Compliance will be met by following site procedures EW-0006, "Management of Excess Soil, Debris, and Waste from a Project", and EW-0002, "Processing the Site-Wide Analysis Request/Custody Record for Sample Control". Silo waste material has already been characterized in accordance with this requirement. 2) Existing site security measures and physical barriers around the silos and the FEMP complex are sufficient to satisfy these requirements. 3) Scheduling for inspection and monitoring of safety and emergency equipment specifically related to the FRVP will be presented in the SOPs that are generated for operation of the facility. 4) All operations personnel will be trained in accordance with existing FEMP requirements. Additional training will be required for the specific job related requirements associated with operation of the FRVP.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Preparedness and Prevention	40 CFR 264, Subpart C OAC 3745-54-31 TSD operators must design, construct, maintain and operate facilities to minimize the possibility of a fire, explosion or any unplanned sudden or non-sudden release of hazardous waste to air, soil, or surface water which could threaten human health or the environment. OAC 3745-54-32 All facilities must be equipped with an internal communication or alarm system, a telephone, or a two-way radio for calling outside emergency assistance, fire control, spill control and decontamination equipment and water at an adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers or water spray systems. OAC 3745-54-33 All fire and spill-control and decontamination equipment must be tested and maintained as necessary to assure proper emergency operation. OAC 3745-54-34 All personnel must have immediate access to emergency communication or alarm systems whenever hazardous waste is being handled at the facility. OAC 3745-54-35 Aisle space must be sufficient to allow unobstructed movement of personnel, fire and spill control, and decontamination equipment. OAC 3745-54-37 Operators must attempt to make arrangements, appropriate to the waste handled, for emergency response by local and state fire, police and medical personnel.	Relevant and Appropriate	The existing FEMP site-wide communications/alarm system will accommodate operation of the FRVP. A fire protection system will be included at the FRVP. In addition, portable fire extinguishers and spill control and decontamination equipment will be placed at accessible locations to assist in emergency response. The facility will be designed to include adequate aisle space. The site's Emergency Response Team will be properly trained and available, with assistance from local and state personnel, for responding to emergency situations related to the FRVP.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Treatment, Storage, or Disposal Facility Contingency Plan and Emergency Procedures	40 CFR 264, Subpart D 40 CFR 264.51 OAC 3745-54-51 Each facility operator must have a contingency plan designed to minimize hazards to human health or the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to the air, soil, or surface/groundwater. 40 CFR 264.52 OAC 3745-54-52 Contingency plans should address procedures to implement a response to hazardous waste incidents, and provide internal and external communications, arrangements with local emergency authorities, an emergency coordinator list, a facility emergency equipment list indicating equipment descriptions and locations, and a facility personnel evacuation plan. A copy must be maintained at the site as well as submitted to appropriate emergency agencies. 40 CFR 264.55 and .56 OAC 3745-54-55 & 56 Each facility must have an emergency coordinator who has responsibility for coordinating all emergency response measures, is on the premises or on call at all times, is thoroughly familiar with all aspects of the contingency plan, facility operations, location and characteristics of waste handled, location of pertinent records, and facility layout, and who has the authority to commit the resources necessary to implement the contingency plan in the event of an emergency.	Relevant and Appropriate	Specific procedures to respond to emergencies and unplanned events or releases associated with the FRVP will be addressed in the SOPs for the plant. Existing site procedures, such as the FEMP Emergency Plan (PL-3020), Spill Incident Reporting and Cleanup (EP-0004), and Event Notification and Reporting (EM-0010) will be implemented as is appropriate for spills, fires, or other emergencies. In addition, procedures specific to operations at the K-65 silos, i.e., "K-65 Silo Numbers 1 and 2 Area Emergencies (SOP 65-C-201)" and "Radon Treatment System Emergencies (SOP 66-C-909)", will be revised, as necessary, and implemented, as applicable, to the FRVP.
Releases from Solid Waste Management Units	40 CFR § 264, Subpart F (OAC 3745-54-91 - 3745-54-99 and 3745-55-01 - 3745-55-11) Operators of TSDFs must implement the following programs and program elements to monitor releases. • Groundwater protection standards • Hazardous constituents • Point of compliance • General groundwater monitoring requirements • Detection monitoring program • Compliance monitoring program	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Closure	40 CFR § 264, Subpart G 40 CFR § 264.111, 264.114, and 264.116 (OAC 3745-55-11, 3745-55-14, and 3745-55-16) Operators must close a facility in a manner that: • Minimizes the need for further maintenance • Minimizes post-closure escape of hazardous constituents • Complies with specific unit type closure requirements. All contaminated equipment, structures and soils must be properly disposed or decontaminated. Following closure, a survey plot showing the location of hazardous waste disposal units with respect to surveyed benchmarks must be filed with the legal total zoning authority.	Relevant and Appropriate	Decontamination, demolition, and disposition of the FRVP and storage silos will be in accordance with strategies and methodologies consistent with the OU3 ROD and the Removal Action 17 Work Plan. Contaminated soils will be excavated and managed in accordance with strategies and methodologies consistent with the OU5 ROD and the Removal Action 17 Work Plan.
Post-Closure	40 CFR § 264.117 (OAC 3745-55-17) 40 CFR § 264.119 (OAC 3745-55-19) Establishes post-closure care and use of property for a period as necessary to protect human health and the environment including: • Access controls • Monitoring Post-closure notices must include deed notation/use restrictions.	Relevant and Appropriate	Decontamination, demolition, and disposition of the FRVP and storage silos will be in accordance with strategies and methodologies consistent with the OU3 ROD and the Removal Action 17 Work Plan. Contaminated soils will be excavated and managed in accordance with strategies and methodologies consistent with the OU5 ROD and the Removal Action 17 Work Plan. The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Container Storage	40 CFR 264.171 - 178 Subpart I OAC 3745-55-71 through 78 1) Containers of RCRA hazardous waste must be: a) Maintained in good condition; b) Compatible with hazardous waste to be stored; and c) Closed during storage (except to add or remove waste) d) Managed in a manner that will not cause the container to rupture or leak 2) Storage areas must be inspected weekly for leaking and deteriorated containers and containment systems. 3) At closure, remove all hazardous waste and residue from the containment system, and decontaminate or remove all containers, liners, bases, and contaminated soils.	Relevant and Appropriate	Compliance with this requirement will be as follows: 1) Closed containers of vitrified product will be stored on-site in an interim storage facility. The containers will be compatible with the waste products. 2) Since the vitrified product will not contain free liquids, the storage area will be designed only to prevent run-on. Since the stored product will pose a significant radiation hazard, the frequency of inspection will be limited in accordance with ALARA principles. The waste product storage area will be shielded to minimize the radiation hazard, and monitored for radon released from stored material. 3) Closure of the storage area will not be included in the scope of this project. Closure of the area will be part of final site remediation activities for OU4. Vitrified waste product will no longer be "sufficiently similar" to hazardous waste since it will no longer exhibit a RCRA characteristic. Containers of other solid waste awaiting characterization, or material characterized as hazardous waste will be managed in accordance with Management of Soil, Debris, and Waste from a Project (EW-0006).

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Tank Systems	40 CFR 264, Subpart J (Tanks) OAC 3745-55-91 through 96; and 3745-55-97(A) Design, operating, and inspection standards for tank units within which hazardous waste is stored or treated. • Tank design must be compatible with the material being stored. • Tank must be designed and have sufficient strength to store or treat waste to ensure it will not rupture or collapse. • Tank must have secondary containment that is capable of detecting and collecting releases to prevent migration of wastes or accumulated liquid to the environment. • At closure, remove all hazardous waste and residue from the containment system, and decontaminate or remove all tanks, liners, bases, and contaminated soils.	Relevant and Appropriate	All process tanks will be constructed with durable material that is compatible with the waste and treatment process for which the tank is designed. The facility design will include secondary containment capable of collecting releases. Approved SOPs which will include scheduled visual inspections of all tanks, will be established prior to initiation of FRVP operations.
Closure Requirements for Tanks	40 CFR § 264.197 (OAC 3745-55-97) At closure, the facility owner must do the following: • Remove all waste residues • Remove or decontaminate all tank system components • Remove or decontaminate all contaminated soils and residues • Manage all of the above as hazardous waste • If all contaminated soils cannot be removed, the landfill requirements of 40 CFR § 264.310 apply.	Relevant and Appropriate	Decontamination, demolition, and disposition of tank systems associated with the FRVP, as well as the storage silos will be in accordance with strategies and methodologies consistent with the OU3 ROD and the Removal Action 17 Work Plan.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Landfill Capping	40 CFR § 264.310 (OAC 3745-57-10) Placement of a cap over waste (e.g., closing a landfill, or closing a waste pile as a landfill, or similar action) requires a cover designed and constructed to: • Provide long-term minimization of migration of liquids through capped area • Function with minimum maintenance • Promote drainage and minimize erosion or abrasion of the cover • Accomodate settling and subsidence so that the cover's integrity is maintained • Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present • Prevent run-on and run-off from damaging cover • Protect and maintain surveyed benchmarks used to locate waste cells (landfills, waste piles) • Maintain the integrity and effectiveness of final cover, including making repairs to the cap as necessary to correct effects of settling, subsidence, erosion, or other events, monitoring of leachate and groundwater monitoring.	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.
Miscellaneous Units	40 CFR 264 Subpart X OAC 3745-57-91 and 92 Environmental performance standard, monitoring, inspection, and post-closure care for treatment in miscellaneous units as defined by 40 CFR 260.10. 40 CFR 264.601 OAC 3745-57-91 Locate, design, construct, operate, close, and maintain to protect human health and the environment and prevent releases to groundwater, subsurface water, surface water, wetlands, soil, and air. Permit terms shall use Subpart I through O, Part 270, and Part 146 requirements as appropriate. 40 CFR 264.602 OAC 3745-57-92 Monitoring, testing, analytical data, inspections, response, and reporting procedures must ensure compliance with 40 CFR 264.601, 264.15 (general inspection requirements), 264.33 (testing and maintenance of emergency equipment), and 264.77 (reports of releases, fires, explosions, and closures).	Relevant and Appropriate	The vitrification melter could be considered a miscellaneous unit. Although no permit is required for this activity, the design, construction, operation, and maintenance of the unit will be in accordance with this Subpart, other ARARs, DOE orders, and accepted construction standards and practices, as appropriate. Included in the design will be secondary containment and emission controls to ensure that releases to air or water are limited, or meet stipulated requirements or limits. Monitoring and inspection activities will be conducted to ensure compliance with these requirements.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Corrective Action for SWMUs (Solid Waste Management Units)	40 CFR Subpart S 40 CFR 264.552 and 553 Corrective Action Management Units (CAMUs) might be designated at the site as areas where remediation wastes (solid, hazardous, or contaminated media and debris) might be placed during the process of remediation. Temporary units (TUs) consisting of tanks and container storage units might be used to store and treat hazardous waste during the process of corrective action.	Relevant & Appropriate	During D&D and soil remediation activities for OU4, materials could be managed in containment buildings, TUs, stockpiles or other land-based units for the purpose of staging, treating, and preparation for shipment without triggering the land disposal restrictions (LDRs).
Containment Buildings	40 CFR 264, Subpart DD Hazardous waste and debris may be placed in units known as containment buildings, as defined in 40 CFR 260.10, for the purpose of interim storage or treatment. 40 CFR 264.1101 Containment buildings must be fully enclosed to prevent exposure to the elements and ensure containment of managed wastes. Floor and containment walls must be designed and constructed of materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit. All surfaces coming in contact with hazardous waste must be chemically compatible with waste. Primary barriers must be constructed to prevent migration of hazardous constituents into barrier. Secondary containment systems including secondary barrier and leak detection system must also be constructed for containment buildings used to manage wastes containing free liquids. Controls must be implemented to ensure: the primary barrier is free of significant cracks, corrosion, or other deterioration that may allow release of hazardous waste; the level of hazardous waste does not exceed height of containment walls and is otherwise maintained within containment walls; tracking of waste out of unit by personnel or equipment used in handling waste is prevented; and fugitive dust emissions are controlled at level of no visible emissions.	Relevant and Appropriate	Containment buildings, as defined, are not land disposal units, so they can be used to store prohibited waste prior to treatment or disposal. During the operation of the FRVP, waste materials might require temporary management for the purpose of staging or treating the material. Some of the waste material may be sufficiently similar to hazardous waste to make this requirement relevant and appropriate. Design, construction, operation, and maintenance of the buildings will be in accordance with this requirement, and other ARARs, DOE orders, and accepted construction standards and practices, as appropriate. Included in the design will be run-on control and emission controls to control releases, as appropriate.
Digging Where Hazardous or Solid Waste Was Located	ORC 3734.02(H) Filling, grading, excavating, building, drilling, or mining on land where a hazardous waste, or solid waste facility was operated is prohibited without prior approval from the Director of the Ohio EPA.	Applicable	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Radiation Dose Limit (All Pathways)	DOE Order 5400.5, Chapter II, Section 1.a The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem from all exposure pathways.	To Be Considered	Operation of the OU4 FRVP could result in release of radiation sources that could contribute to the total dose to members of the public. The facility design will include HEPA filtration to control radionuclide and particulate emissions where appropriate. Monitoring of air emissions from the FRVP will be conducted in accordance with the methods referenced in 40 CFR 61.93 with compliance being demonstrated using an EPA approved computer code. Releases to water will be controlled by design and operation of secondary containment features and treatment in the FEMP AWWT system. Excavations, excavated soil and other sources of particulate emissions will be controlled, as appropriate, through good construction practices.
Ohio Water Well Standards	OAC 3745-9-10 Upon completion of testing, a test hole or well shall be either completely filled with grout or such material as will prevent contaminants from entering groundwater.	Applicable	Test borings and/or wells might be installed or utilized as part of OU4 RA activities. Abandonment of any borings or wells during the duration of this project will comply with established site procedures.
Control of Fugitive Dust	OAC 3745-17-08 Requires the minimization or elimination of visible emissions of fugitive dust generated during grading, loading, or construction operations and other practices which emit fugitive dust.	Relevant and Appropriate	Excavations, excavated soil and other sources of fugitive dust emissions during construction will be controlled, as appropriate, through established FEMP construction practices.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Prevention of Air Pollution Nuisance	ORC 3704.01-.05 OAC 3745-15-07 Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared a public nuisance and is prohibited.	Applicable	FRVP design will include a scrubber system, NO_x removal system (if necessary), and HEPA filters to control particulate and acidic gas emissions. Excavations, excavated soil and other sources of particulate emissions will be controlled through established FEMP construction practices.
Permit to Install	OAC 3745-31-05(A)(3) The installation of new sources or modification of existing sources requires the use of best available technology to control emissions.	Relevant and Appropriate	Though a permit to install is not required for the FRVP (permits are administrative requirements which are excluded under CERCLA), the substantive requirements must be met by employing BAT for treating particulate and off-gas emissions. This requirement will be met by using a scrubber system for treatment of particulates and acidic gas emissions, an NO_x removal system (if necessary), followed by HEPA filters for final particulate removal.

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Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Restriction on Particulate Emissions from Industrial Processes	OAC 3745-17-11 Any source (operation, process, or activity) shall be operated so that particulate emissions do not exceed allowable emission rates specified in this regulation (based on processing weights (Table 1) or uncontrolled mass rate of emissions (Figure II)). A source complies with Table 1 requirements if its rate of particulate emission is always equal to or less than the allowable rate of particulate emission based on the maximum capacity of the source: Process Rate at Maximum Capacity (lb/hr) — Allowable Rate of Particulate Emission (lb/hr)[1] 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58 [1] Excerpted from Table 1 of OAC 3745-17-1	Applicable	FRVP design will include a scrubber system, NO_x removal system (if necessary), and HEPA filters to control particulate and acidic gas emissions. Excavations, excavated soil and other sources of particulate emissions will be controlled through established FEMP construction practices.
Environmental Radiation Protection Standards for Management and Disposal of HLRW, Spent Nuclear Fuel, and TRU Wastes	40 CFR § 191, Subpart A 40 CFR § 191.03(b) Management and storage of spent nuclear fuel, TRU, or high-level radioactive wastes (HLRW) at all facilities operated by the DOE shall be conducted in such a manner to provide assurance that the combined annual dose equivalent to any member of the public resulting from discharges of radioactive material and direct radiation shall not exceed 25 mrem to the whole body and 75 mrem to any critical organ.	Relevant and Appropriate	Design will help ensure compliance with this requirement via radiation controls and monitoring.
NEPA Compliance	10 CFR 1021.2 DOE actions must be subjected to NEPA evaluation as outlined by Council on Environmental Quality regulations in 40 CFR 1500-1508.	Applicable	NEPA documentation will be prepared for this project in accordance with established site procedures.
Standards for Control of Residual Radioactive Material	40 CFR § 192, Subpart A 40 CFR § 192.02(a) Requires that controls for the residual radioactive material in the proposed on-site disposal facility be effective for 1000 years, where reasonably achievable, or at least 200 years.	Relevant and Appropriate	The on-site FEMP disposal cell will be sited, designed, constructed, and managed in accordance with the OU2 ROD.

Chemical, Location, or Action	Requirement	ARAR/TBC	Strategy for Compliance
Standards for Cleanup of Lands Contaminated with Residual Radioactive Materials	40 CFR § 192, Subpart B 40 CFR § 192.12(a) Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site: The concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than: • 5 pCi/g, averaged over the first 15 cm of soil below the surface, and • 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.	Relevant and Appropriate	Contaminated soils will be excavated and managed in accordance with strategies and methodologies consistent with the OU5 ROD and the Removal Action 17 Work Plan.
Implementation of Health and Environmental Protection Standards for Uranium Mill Tailings	40 CFR § 192, Subpart C Establishes guidance for remedial activities involving control and cleanup of residual radioactive material from OU4.	Relevant and Appropriate	Design will be in accordance with guidance presented in this Subpart.

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APPENDIX B

FERMCO Letter No. C:(CRU4/RPP):95-0016,
Size and Number of Melters for CRU4 Remediation

Fernald Environmental

FERMCO
Restoration Management Corporation P.O. Box 398704 Cincinnati, Ohio 45239-8704 (513) 738-6200

June 22, 1995

Fernald Environmental Management Project
Letter No. C:CRUP(CRU4/RPP):95-0016

Anthony Pyrz
Ralph M. Parsons Company
6120 S. Gilmore Road
Fairfield Executive Center
Fairfield, Ohio 45014

Dear Tony:

SIZE AND NUMBER OF MELTERS FOR CRU4 REMEDIATION

CRU4 has recently completed a life-cycle cost study to determine which is the most economical size and number of melters combination for the remediation of the OU4 wastes. The best combination has been determined to be three 8-tons glass/day melters. Please use this as the design basis for the CRU4 full-scale remediation facility, and the data included in this letter will be incorporated into the Design Criteria Package when issued. The following are key assumptions used in making this determination:

1. K-65 and Silo 3 wastes are blended to make only one type of glass.

2. The Pilot Plant Melter tests at and performs continuously at 2-tons glass/day with a 50 wt% solids slurry.

3. The Pilot Melter can be scaled-up by a factor of four which equates to a full-scale melter size of 8-tons glass/day.

4. The vitrification facility will be operated 24-hours/day, 275 days per year. Rebricking of the melter will be required after approximately 3 years of operation which is the estimated life of the refractory brick lining in the melter.

5. Glass formulation (and resultant waste loading) is based on an operating temperature of 1250°C. Amount of additives was calculated by using the PNL Crucible Melt D14 (from the OU4 Vitrification Treatability Study) as a basis. However, the melt constituents and additives were adjusted (as shown in the enclosed spreadsheet) to:

Fernald Environmental
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Restoration Management Corporation

- Lower the melt's melting temperature to 1250°C
- Include bentonite from the caps in the silos
- Adjust the CaO/Na_2O ratio in the formulation to adhere to PNL's recommendation of ≥2. PNL noticed that a high ratio promoted the destruction of sulfate in the glass melt.
- Adjust the Al_2O_3/P_2O_5 ratio in the formulation to adhere to PNL's recommendation of ≥1.9. PNL noticed that a high ratio promoted the dissolution or containment of phosphate in the glass melt.

Based on the above glass formulation, the estimated OU4 remedial quantities are as follows:

	Waste, tons (dry)	Sulfates, carbonates Wt. Loss, wt%	Parts/100 Parts Glass, wt	Glass, tons
Silo 1	5,216	6.14	24.68	4,896
Silo 2	4,519	6.75	21.38	4,214
Silo 3	3,918	26.47	18.54	2,881
Bentonite	878	14.23	4.15	753
Additives	--	--	39.70	8,390
Total	14,531	8.45	108.45	21,134

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Restoration Management Corporation

The economical life-cycle cost study showed that three melters of maximum size (8 tons glass/day) was the most economical number. Results of this study are shown in the enclosed summary table and figure. The amount of time to process the OU4 waste is approximately 3.2 years:

(21,134 tons glass)/(275 days/yr)(3 melters)(8 tons glass/day/melter) = 3.2 yrs.

Rebricking is not considered necessary since the processing time is close to the estimated life of the refractory bricks.

Sincerely,

Roger Emerton, Supervisor
Remedial Design

RCE:cml
Enclosures

c: Without Enclosures
M. L. Dehring
R. F. Gimpel
S. A. Haller
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Functional Requirements Document
Fernald Residues Vitrification Plant

CERCLA/RCRA Unit 4
August 1995
Pre-Final (90%) - Revision 0

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio

DRAFT

Functional Requirements Document
Fernald Residues Vitrification Plant

APPROVED FOR ISSUE

Approved By:

Keith Hampton, CRU4 Engineering Manager, FERMCO Date

Mark Dehring, FRVP Project Manager, FERMCO Date

Mark Dehring, Acting CRU4 Director, FERMCO Date

Randi Allen, OU4 Team Leader, DOE-FN Date

DRAFT

Functional Requirements Document
Fernald Residues Vitrification Plant

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ACRONYM LIST

ALARA	As Low As Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
AWWT	Advanced Wastewater Treatment System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDR	Conceptual Design Report
CRU4	CERCLA/RCRA Unit 4
D&D	Decontamination and Decommissioning
DBA	Design Basis Accident
DCP	Design Criteria Package
DCS	Distribution Control System
DOE	United States Department of Energy
DOT	United States Department of Transportation
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FSAR	Final Safety Analysis Report
FRD	Functional Requirements Document
FRVP	Fernald Residues Vitrification Plant
FS	Feasibility Study
NTS	Nevada Test Site
O&M	Operation and Maintenance
OU4	Operable Unit 4
PSAR	Preliminary Safety Analysis Report
QA	Quality Assurance
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TBC	To Be Considered

PROJECT GLOSSARY

Fernald Residues Vitrification Plant (FRVP) project is being implemented as part of the OU4 RD/RA under CERCLA. It includes all facilities associated with silo residue retrieval, treatment, packaging and staging for off-site shipment. The FRVP may include or share systems or facilities constructed for the Vitrification Pilot Plant. This has been previously referred to as the Silo Residue Retrieval/Treatment Facility (SRR/TF).

Vitrification Pilot Plant (VPP) project is being implemented in support of the OU4 RD/RA as a post-ROD Treatability Study.

New Radon Treatment System is the system to be used for the reduction of radon in the Silo 1 and 2 headspace in support of residue retrieval activities.

Functional Requirements Document
Fernald Residues Vitrification Plant

1.0 INTRODUCTION AND BACKGROUND

The purpose of this document is to establish the functional requirements for the Fernald Residues Vitrification Plant (FRVP) project at the Fernald Environmental Management Project (FEMP). OU4 is currently in the Remedial Design/Remedial Action (RD/RA) phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process which was initiated by the *Final Record of Decision for Remedial Actions at Operable Unit 4* (ROD) on December 7, 1994. Briefly, the ROD can be summarized as the retrieval, stabilization by vitrification of the contents of Silos 1, 2 and 3, and off-site disposal at the Nevada Test Site (NTS), as well as the demolition, removal, and final disposition of the contaminated concrete, debris, and soils within OU4.

This Functional Requirements Document (FRD) will establish the functional requirements for the FRVP project which shall be satisfied in order to achieve remediation objectives identified in the ROD. The functional requirements do not address detailed design requirements, but rather establish the technical baseline for the development of Title I and Title II engineering and design. This technical baseline allows for the tracking of the final detailed system requirements back to their origin (functionality) for future assessment of the design with respect to the project's original goals, objectives, and requirements. This document presents the elements of the project to be designed and the functions each element must be capable of performing. This FRD was prepared based on the FEMP Engineering Procedure Number *ED-12-4001, Functional Requirements Document*, Revision 0, September 16, 1994.

In concurrence with the CERCLA Remedial Investigation/Feasibility Study (RI/FS) activities and in accordance with DOE Order 4700.1, the *OU4 Remedial Action Conceptual Design Report* (CDR), December 1992, was approved by the U.S. Department of Energy (DOE) in January 1993. Within the CDR, the functional requirements to achieve the OU4 remediation objectives were identified. While many of the requirements have not changed since the CDR was approved, the completion of the FS and approval of the ROD has caused sufficient modification to the original functional requirements to warrant replacement of those previously identified in the CDR with this FRD.

2.0 DOCUMENT SCOPE

The functional requirements identified in this FRD cover only the FRVP.

Completion of the OU4 remedial actions will be via an integrated, site-wide approach as follows:

- Vitrification and final disposition of the Silos 1, 2, and 3 residues shall be implemented under the scope of OU4 in accordance with the OU4 ROD.

- D&D and final disposition of the silos and miscellaneous structures within the OU4 area will be implemented under the scope of OU3 in accordance with the OU4 and OU3 RODs.

- Soil and perched water remediation and final disposition shall be implemented under the scope of OU5 in accordance with the OU4 and OU5 RODs.

The first bullet identified above will be conducted under the FRVP project.

3.0 GENERAL FUNCTIONAL REQUIREMENTS

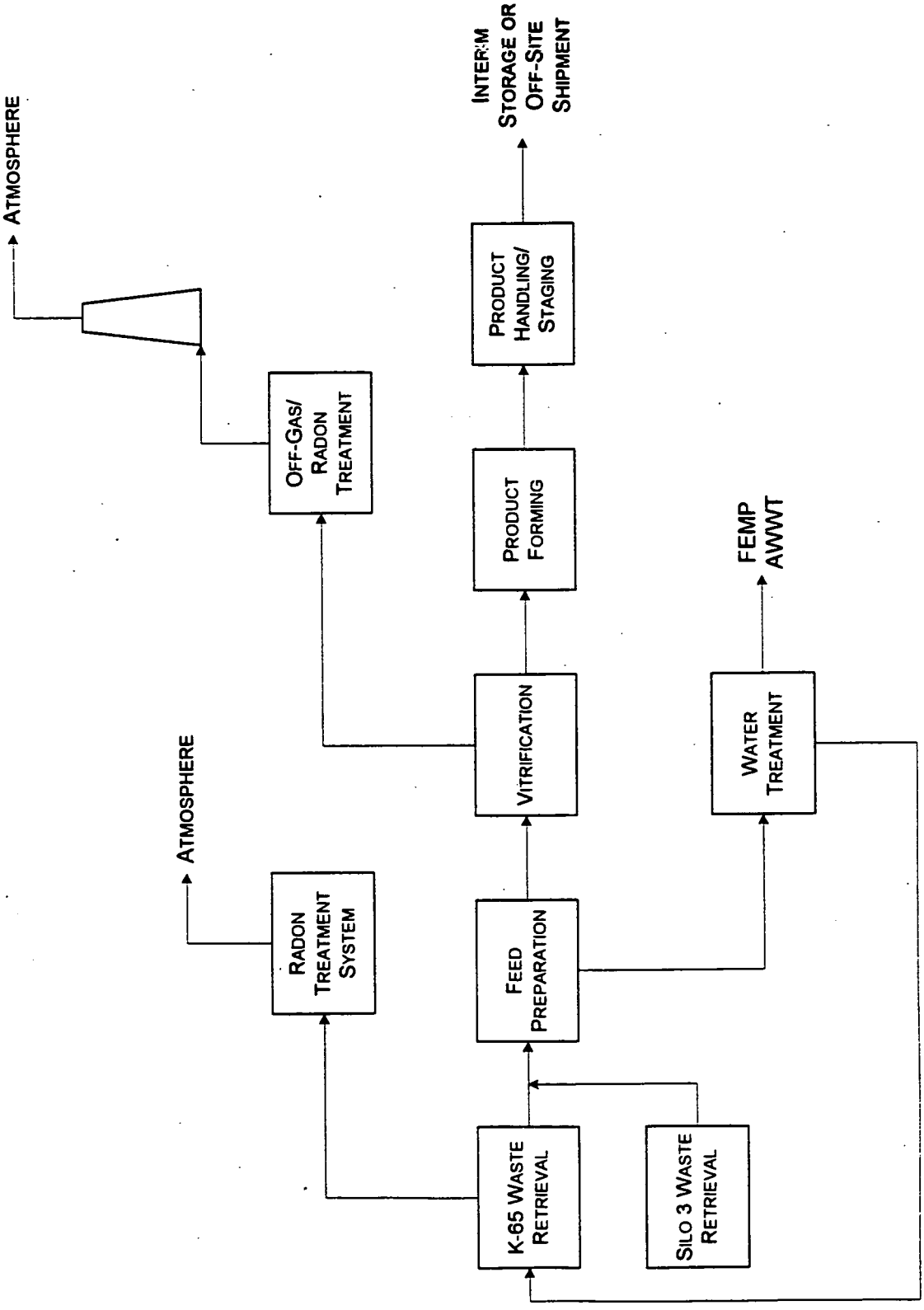
As a remediation project being conducted under CERCLA, the approved ROD issued by the Environmental Protection Agency (EPA) for OU4 inherently defines the scope of the FRVP project. This section summarizes the selected remedy for OU4 (summarized from the OU4 ROD) relative to the FRVP and the general functional requirements that the FRVP shall meet. See Figure 3-1 for a block flow diagram of the primary functional elements of the FRVP.

3.1 Selected Remedy - FRVP

Under the selected remedy, the K-65 residues (Silos 1 and 2) and cold metal oxides (Silo 3) will be removed from the silos and the K-65 Decant Sump Tank and treated in a newly constructed on-property vitrification facility. The treatment will consist of vitrification to stabilize the residue for final disposition. Following treatment, the vitrified residues will be containerized and transported off-site for disposal at the NTS.

Figure 3-1

FRVP Functional Block Flow Diagram



3.2 Silo Residue Retrieval

Silos 1 and 2 residues shall be slurried and pumped (hydraulically transferred) to the vitrification facility for processing. During the residue retrieval phase, Silos 1 and 2 shall be equipped with a new radon treatment system to mitigate the release of radon and its associated daughter products. The New Radon Treatment System shall reduce direct radiation exposure to personnel working in the silo exclusion area, while meeting air emission regulations identified in the Applicable or Relevant and Appropriate Requirements (ARARs).

The K-65 Decant Sump Tank shall be monitored during Silo 1 and 2 residue retrieval activities and pumped as necessary.

Due to the powdery nature of the Silo 3 cold metal oxide residues, a pneumatic process shall be used to retrieve and transport the contents of Silo 3 to the vitrification facility. Totally enclosed lines and containment vessels equipped with in-line filters shall be used to prevent releases to the atmosphere during operations.

3.3 Treatment

Silos 1, 2, and 3 residues shall be mixed with glass forming agents (additives), processed in a melter, and converted into a stable glass (vitrified) form to meet off-site disposal waste acceptance criteria for durability and constituent leaching characteristics. The final product form determination shall consider glass quality, off-quality product remelt, containerization, shipping, and final disposition requirements. A process off-gas handling system shall be provided to reduce potential radon and particulate emissions to the atmosphere during treatment operations.

3.4 Off-Site Shipment Preparation

The containerized vitrified product will require periodic sampling to verify that it has met the waste disposal criteria. This, along with shipment preparation activities shall occur at a product staging area at the vitrification facility. In addition, an interim storage area shall be required to provide a buffer for off-site shipment. Off-site shipment shall meet all applicable U.S. Department of Transportation (DOT) regulations, as well as the requirements of the NTS.

4.0 REGULATORY REQUIREMENTS

CERCLA remedial actions must achieve standards or levels of control that are consistent with environmental laws or regulations, which are termed ARARs. A complete list accompanied by a detailed discussion of the ARARs and "To Be Considered" (TBC) criteria identified for OU4 is provided in the OU4 ROD. All activities undertaken as a result of the ROD, must comply with the ARARs and TBCs that pertain to the activity. The FRVP project shall comply with the identified ARARs and TBCs.

The ARARs and TBCs identified, as they appear in the EPA approved OU4 ROD, are considered final with regard to the FRVP project. Compliance with regulatory requirements that are newly promulgated or modified after execution of the ROD will not be enforceable and will be considered only when determined to be applicable, or relevant and appropriate, and necessary to ensure that the remedial action is protective of human health and the environment.

5.0 NUCLEAR SAFETY AND RADIATION PROTECTION REQUIREMENTS

The FRVP shall be designed based on the requirements of a Non-Reactor Nuclear Facility (Special Facility) as defined by DOE Order 6430.1A. Radiation protection shall comply with the ARARs and TBCs identified for this project and ALARA principles. This project will not involve the handling, storage, or treating of special nuclear materials as defined by DOE Order 6430.1A; therefore, safeguards for these materials are not required.

In accordance with DOE Order 6430.1A, Section 1300-1.3, the FRVP shall:

1) Protect the public and facility personnel from hazards associated with the use of radioactive and other hazardous materials as a result of normal operations, anticipated operational occurrences, and Design Basis Accident (DBA) conditions, including the effects of natural phenomena pertinent to the FEMP, and maintain these effects As Low As Reasonably Achievable (ALARA);

2) Ensure compliance with DOE and FEMP policies regarding nuclear safety, criticality safety, radiation safety, industrial safety, fire protection, and environmental protection;

3) Protect government property and essential operations from the effects of potential accidents; and

4) Minimize exposures of personnel and the general public to hazardous materials by emphasizing ALARA concerns during all design, construction, and operational and maintenance phases.

The FRVP shall be designed accordingly to satisfy these requirements. A Preliminary Safety Analysis Report (PSAR) and Final Safety Analysis Report (FSAR) will be prepared in support of this project as required by DOE Order 6430.1A.

6.0 REFERENCE MATERIALS

The purpose of this section is to identify the primary project reference documents which apply to, and shall be used for reference during, the remedial design. The primary references include those documents prepared to date that support the FRVP project, as well as those project documents to be produced in the future in support of this project (identified without a publication date). Note that specific codes, standards, and DOE Orders which apply to this project will be identified in the DCP for this project.

The following are the primary reference documents which apply to this project:

1. United States Department of Energy, *Characteristics of Fernald's K-65 Residue Before, During, and After Vitrification*, February 1991.

2. United States Department of Energy, *Operable Unit 4 Remedial Action Conceptual Design Report*, Volumes 1, 2, and 3, December 1992.

3. United States Department of Energy, *Operable Unit 4 Treatability Study Report for the Vitrification of Residues from Silos 1, 2, and 3*, May 1993.

4. United States Department of Energy, *Final Remedial Investigation Report for Operable Unit 4*, Volumes 1, 2, and 3, November 1993.

5. United States Department of Energy, *Final Feasibility Study Report for Operable Unit 4*, Volumes 1, 2, 3, and 4, February 1994.

6. United States Department of Energy, *Operable Unit 4 Feasibility Study/Proposed Plan - Final Environmental Impact Statement*, September 1994.

7. United States Department of Energy, *Final Record of Decision for Remedial Action at Operable Unit 4*, December 1994.

8. United States Department of Energy, *Design Criteria Package, Fernald Residues Vitrification Plant*

9. *Operable Unit 4 Vitrification Pilot Plant Treatability Study Final Report*

10. *Fernald Residues Vitrification Plant Preliminary Safety Analysis Report* and *Final Safety Analysis Report*

7.0 SPECIFIC FUNCTIONAL REQUIREMENTS

7.1 Residue Retrieval

The contents of Silos 1, 2, and 3 shall be accessed from the top of each silo by an independently supported superstructure to facilitate residue retrieval and material transfer, while adding no undesirable additional loads to the silo domes. Each superstructure shall span the centers of the silos to allow deployment of residue retrieval equipment from above the center of each silo.

The silo domes shall be modified, as necessary, to allow for deployment of retrieval equipment while ensuring stability of the dome structure. The installation and operation of the residue retrieval equipment shall not compromise the structural integrity of the silos.

Bulk material retrieval from Silos 1 and 2 shall be performed with a hydraulic mining device. The hydraulic mining device shall be supported by and deployed from the superstructure. The K-65 material shall be transported from the silos via pipeline to the vitrification feed preparation system.

The K-65 Decant Sump Tank shall remain in place and its liquid level remotely monitored during hydraulic mining operations. As liquid is accumulated in the K-65 Decant Sump Tank, it shall be periodically pumped down. Residue retrieval operations shall accommodate this activity, and the structural integrity of the tank and its associated piping shall not be jeopardized.

Bulk residue retrieval from Silo 3 shall be via pneumatic methods.

Bulk residue retrieval operations from all three silos shall be designed and sized to ensure feed is available for continuous operation of the melter(s).

The design shall account for the retrieval of discrete, non-pumpable objects and "heel" residue retrieval (residue remaining in the silos following bulk retrieval operations) from Silos 1, 2, and 3 to be performed, as necessary, during and following bulk retrieval operations.

The design shall consider remote residue retrieval operations to the extent practical with limited personnel activities required at the silos in accordance with ALARA principles. Residue retrieval operations are to be performed concurrent with vitrification operations.

Engineered and possibly administrative controls shall be used to prevent the spill, release, and spread of radiological contamination during waste retrieval construction and waste retrieval operations. Radon treatment, control, and monitoring shall be required during residue retrieval construction and operations, as well as in the standby mode via the New Radon Treatment System, seals, glove-bags, etc.

7.2 Vitrification Feed Preparation

The K-65 residue shall be received as a slurry at the vitrification facility. The slurry water content shall be reduced to help decrease the heat load on the melter. Excess water shall be recycled for use in the hydraulic retrieval operations and the vitrification facility as needed. The Silo 3 residues shall be received at the vitrification facility in bulk bins for subsequent use as the vitrification formulations dictate.

The dewatered K-65 material and/or the Silo 3 residues shall be blended in slurry tanks with glass additives as necessary to achieve the desired glass formulation.

The vitrification feed preparation system shall be sufficiently sized to ensure continuous operation of the vitrification facility melter(s). This includes the time required for waste and additive filling, mixing, and sampling/analysis. A dedicated laboratory in the vitrification facility shall be considered to supplement the FEMP laboratory, as needed, to ensure the expedited performance of process sample analyses.

7.3 Vitrification

Vitrification of the silo residues shall be on a continuous basis during normal operations. The prepared vitrification feed shall be converted into glass (vitrified) via a melter. The melter shall melt the feed at the temperature required to ensure acceptable final glass product quality. The feed shall be regulated into the melter at the melter design throughput rate. Provisions shall be made for melter feed and discharge shut-off. The vitrification melter design shall limit fugitive radon and other off-gas emissions. Multiple melters shall be used, as necessary, and sized to achieve the FRVP design throughput.

The molten glass discharge rate shall be remotely controlled. Operation of the melter(s) shall be remote with minimal personnel activities required at the furnace in accordance with ALARA principles. However, the vitrification melter design shall consider the accommodation of personnel activities required at the melter while in operation via radiological shielding, heat reduction/protection, emergency venting, and personnel and equipment access ways. Capability for safe shutdown and standby operation of the melter(s) shall be provided.

Provisions shall be made for the remelt of off-quality glass product.

7.4 Glass Product Forming

The molten glass shall be shaped into a specified form. Product forming and cooling shall be at a rate that is adequate to support the melter throughput design, as well as to meet the final glass product acceptance criteria and the conditions necessary for product handling and

storage. Product forming shall be a remote operation, with limited hands-on maintenance, in accordance with ALARA principles.

7.5 Glass Product Handling

The formed glass product shall be discharged into shipping containers and transported to a staging area for pre-shipment activities. The glass product shall be containerized in a manner that meets the requirements of the final disposal site, as well as all shipping/transportation requirements. Provisions shall be made for glass product verification sampling, container weighing, labeling/bar coding, radiological smearing, off-specification product recycling, radiation protection, the heat load from the vitrified product, and empty container storage. In addition, an interim storage area shall be required to absorb minor shipping delays without disrupting normal operation of the FRVP, i.e., the NTS annual winter shutdown, NTS compliance issues, labor disputes. The containerized product shall be readily transportable to and from the staging/interim storage area. In addition, provisions shall be made at the staging/interim storage area for the direct loading of trucks for off-site shipment. The product handling function shall consider remote or automated operation with limited hands-on activity required in accordance with ALARA principles.

7.6 Off-Gas Treatment

Off-gases from the vitrification process shall be treated to meet all ARARs for the project. Treatment functions shall include, but not be limited to, radon removal, acid gas removal e.g. (SO_x and NO_x), particulate removal, as well as moisture and heat removal as required by the off-gas treatment and monitoring equipment. Prior to being discharged to the atmosphere, sampling and monitoring shall be as dictated by the ARARs and as required for process control.

The off-gas treatment system shall be sized to handle off-gases from the entire vitrification process and shall discharge to the atmosphere at a single point. The system design shall consider a turndown capability if it is to service multiple melters.

7.7 Wastewater Treatment

Wastewater discharged from the vitrification process shall be pre-treated as required for acceptance by the FEMP Advanced Wastewater Treatment System (AWWT). Control of the rate of water from the FRVP imposed on the AWWT shall also be as required by the AWWT.