2. FACILITY DESCRIPTION

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2. FACILITY DESCRIPTION

2.1 Introduction

This chapter describes the Sixth CSSF and its operation. The specific requirements applicable to the safety analysis for the Sixth CSSF are provided in subsection 2.2 of this chapter. The Sixth CSSF overview is discussed in subsection 2.3. Subsection 2.4 contains descriptions of the facility with respect to the INTEC. Subsection 2.5 describes the individual processes and design criteria of the Sixth CSSF, and subsection 2.6 identifies the confinement features for the facility. Subsection 2.7 describes the applicable safety support systems for the facility. Subsection 2.8 contains descriptions of the utility and service systems for the Sixth CSSF, and subsection 2.9 provides information on the remaining portions of the facility (e.g., auxiliary and other support systems).

2.2 Requirements

The following parts of the Code of Federal Regulations (CFR), DOE orders, and requirements are applicable to this chapter in support of DOE Order 5480.23 requirements. These requirements are implemented by the INEEL contractor through various INEEL and INTEC procedural and operational controls, as indicated throughout this chapter.

1. 10 CFR 835[1]
2. 10 CFR 72[2]
3. 10 CFR 830.120[3]
4. DOE Order 5400.5[4]
5. DOE Order 414.1A[5]
6. DOE Order 420.1[6]
7. American National Standards Institute (ANSI) 14.5[7]
8. ANSI B31.3[8]
9. American Concrete Institute (ACI) 349[9]
10. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code[10]
11. American Welding Society (AWS) D1.1, D1.2, and D1.4.[11]

2.3 Facility Overview

2.3.1 General

The primary mission of the INTEC is to ensure the safe and secure treatment, storage, and handling of spent nuclear fuel, special nuclear material, and waste by-products for the DOE. One of the past major missions of the INTEC was recovering enriched uranium from spent reactor fuels. The use of solvent extraction processes to recover the fissile materials resulted in radioactive liquid waste. This waste and incidental radioactive waste from INTEC deactivation, decontamination and decommissioning (DD&D) activities are sent to the INTEC Tank Farm tanks prior to calcination.

Feed blends containing the radioactive liquid waste from the INTEC Tank Farm are transferred to the NWCF calciner for atomization in a hot-air, fluidized bed of granular solids. Chemical and fission product salts in the waste coat the bed particles and are converted to metallic salts (calcine). Calcine is then transported by air to the CSSFs.

There are currently seven calcined solids storage facilities at the INTEC. The First through Fifth CSSFs are considered full. The Sixth CSSF is being filled, and the Seventh CSSF is waiting to be filled.

2.3.2 Sixth CSSF

The Sixth CSSF is an interim storage facility for the resultant granular solids from the calcination of radioactive, aqueous waste generated from the past reprocessing of spent nuclear fuels and from DD&D activities at the INTEC. The calcined solids are transferred from the NWCF and distributed to the Sixth CSSF bins. The seven stainless-steel bins are enclosed by a reinforced concrete vault. The bins are the primary containment for the calcined solids. The bins are labeled consecutively as VES-WS6-154 through VES-WS6-160. The reinforced concrete storage vault provides the secondary containment if the bins are breached. The Sixth CSSF is designed to store approximately 55,200 ft^3 (1,560 m^3) of calcined solids for 500 y.[12] The Sixth CSSF major components and systems are the vault, bins, and associated instrumentation and controls. The Sixth CSSF is shown in Figure 2-1.

The pneumatic transport of the calcined solids from the NWCF to the Sixth CSSF occurs via the transport air line that enters near the top of the vault wall in the inlet plenum room. The calcined solids enter the cyclone located in the cyclone cell room. The calcined solids and transport air are separated in the cyclone. The calcined solids are distributed from the cyclone to the bins by individual bin fill lines. The transport air is returned to the NWCF calciner in the transport return line for treatment and discharged via the INTEC Main Stack.

Radioactive decay heat, produced from the calcined solids, is removed by natural vault cooling air convection or by operation of the vault blowers. The calcined solids can be retrieved from the bins and transported through the retrieval access lines for final disposition.

2.3.3 Plant Feed

Retrieval of the calcined solids is desired for final disposition. If agglomeration occurs, retrieval can be difficult. The agglomeration temperature for the calcined solids varies with the type of waste and fraction of sodium plus potassium (Na+K) in the waste. Calcined solids retrievability studies are performed to establish the storage temperature limits. The feed to the NWCF is controlled to ensure retrievability of the calcined solids.

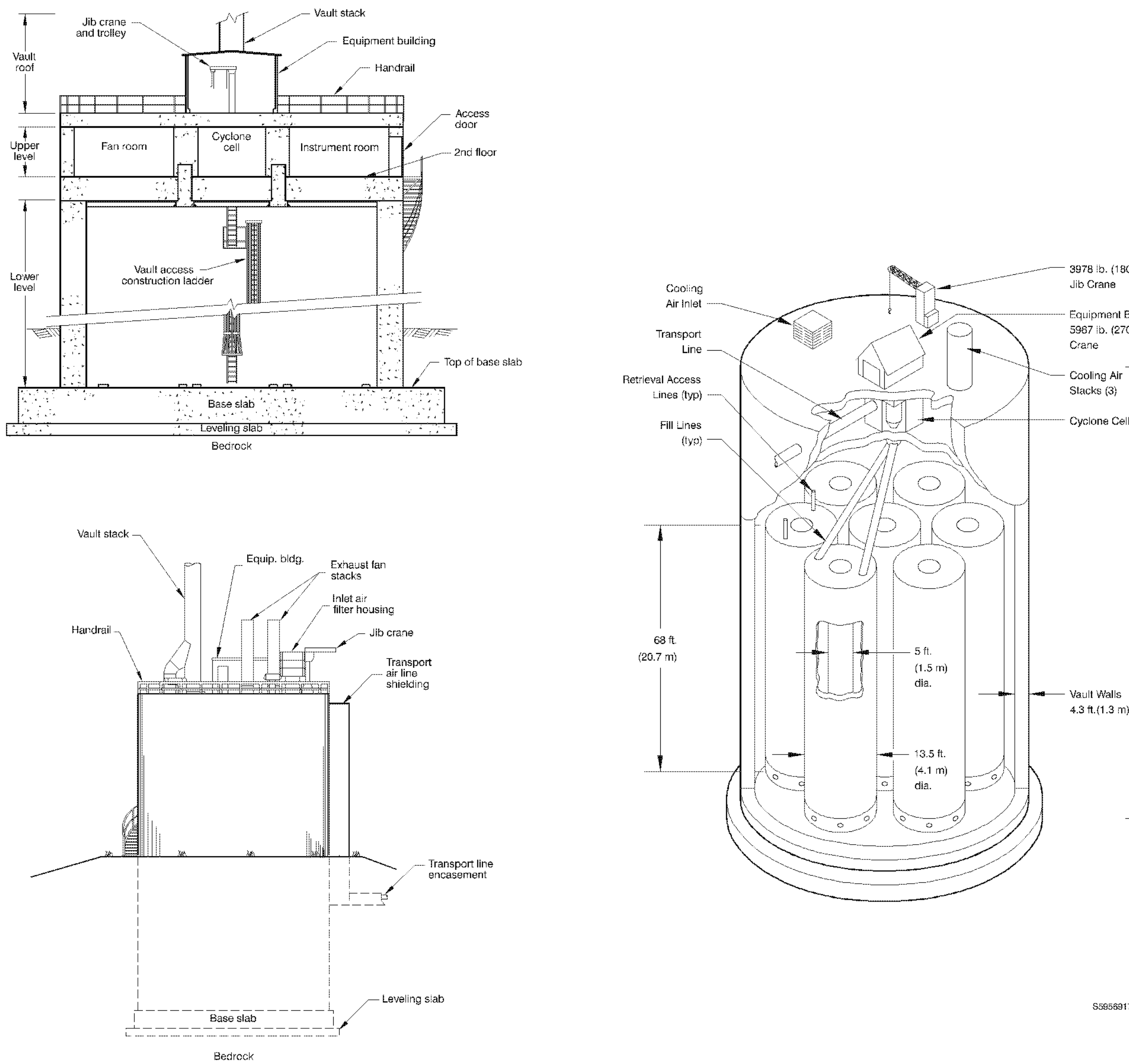

Figure 2-1. The Sixth CSSF.

The design criteria specified the type of calcined solids expected to be stored in the Sixth CSSF.[13] Since then, calcined solids with different compositions were placed in the Sixth CSSF prior to the NWCF H-4 campaign. The calcined solids to be generated and stored during the H-4 and subsequent campaigns contain different properties than those previously stored. The current and proposed calcined solids are enveloped by the original design criteria. The following subsections describe the properties of the design, current, and future calcined solids.

2.3.3.1 Design Calcined Solids. The original design criteria for the calcined solids indicated that the Sixth CSSF would store a mixture of granular solids and powdery fines. The structural analysis used conservative bulk density values of 110 to 115 lb/ft^3 (1,762 to 1,842 kg/m^3) for the calcined solids. The maximum allowable temperature of the calcined solids was 1,100°F (593°C). The maximum allowable decay heat generation rate was 40 Btu/ft^3 h (412 W/m^3) with a thermal conductivity of 0.11 Btu/h ft °F (0.19 W/m°K).

The shear properties of the calcined solids, as determined by a triaxial compression test, vary with increasing compaction from 5 to 37.5 degree phi-angle--tan^{-1} shear stress to normal stress ratio. The design criteria[12] indicated that the calcined solids act as a liquid. The structural analysis[13] also used a liquid behavior for the calcined solids. However, the calcined solids are granular, which causes friction in the bins. An additional vertical force occurs on the bin walls because of the friction. However, the original design analysis is conservative, as indicated by an additional study.[14] The typical properties of these calcined solids are summarized in Table 2-1.[15,16]

2.3.3.2 Calcined Solids Prior to NWCF H-4. The majority of the calcined solids transported to the Sixth CSSF prior to the NWCF H-4 campaign was a mixture of granular solids and powdery fines consisting of mixed oxides and fluorides. These calcined solids resulted primarily from the calcination of aluminum, sodium, and zirconium wastes. In addition, Bin VES-WS6-154 contains 43 ft^3 (1.22 m^3) of pilot plant calcine consisting of nonradioactive fluorinel and sodium waste.

The Na+K content was limited to 5.3 mole-% to prevent agglomeration of the calcined solids.[17] Steady-state thermal analyses were performed to determine the heat transfer characteristics of the Sixth CSSF for both natural convection and forced-air cooling in the vault. The thermal analyses data were based on the original design criteria for the calcined solids. It was concluded that calcined solids with a maximum decay heat generation rate of 32.7 Btu/ft^3 h (337 W/m^3) could completely fill the bins without violating any thermal constraints using natural convection cooling only.[18] Similarly, it was determined that a maximum of 40.2 Btu/ft^3 h (414 W/m^3) could be stored if the Sixth CSSF blowers were operating continuously.[19] Typical properties of these calcined solids are summarized in Table 2-1.[15]

2.3.3.3 Calcined Solids for NWCF Calciner Operations. The bulk of remaining and projected waste to be calcined is expected to generate less decay heat because of the change in the INTEC mission; i.e., fuel reprocessing is no longer conducted. New evaluations have determined that it is not possible for the projected calcine to be processed to generate enough decay heat to exceed the maximum calcine storage temperature of 572°F (300°C). This is based on sampling, current analytical analysis, estimates for composition of the waste currently in the Tank Farm[20] and a conservative analysis[21] that accounts for the combination of projected calcined solids with the existing calcined solids in the bins. The results indicated that the addition of calcined solids with a heat content of 12.7 Btu/ft^3 h (131 W/m3) was required before reaching the 572°F (300°C) limiting temperature with the most conservative bin layer configuration.[21] For existing waste in the Tank Farm, the maximum calcine heat generation rate is less than 4.8 Btu/ft^3 h (50 W/m3).[20]

Table 2-1. Typical properties of the Sixth CSSF Calcined Solids.

Property		Design Criteria Calcine	Aluminum[a]	Aluminum/ Fluorinel/ Sodium[a]	Fluorinel/ Sodium[a]	Sodium/ Aluminum Nitrate[b]
Na	(weight-%)		2.3	2.2	2.9	6.7
K	(weight-%)		—	0.5	0.6	1.5
Al	(weight-%)		48.0	26.6	11.0	36.9
Zr	(weight-%)		—	6.0	8.9	0.4
B	(weight-%)		0.2	0.7	1.0	0.4
F	(weight-%)		—	14.0	15.9	1.1
Ca	(weight-%)		—	21.9	31.1	3.1
Cd	(weight-%)		—	3.3	4.9	0.1
SO_4	(weight-%)		1.2	—	—	0.8
Fe	(weight-%)		0.4	0.5	0.4	0.5
O	(weight-%)		44.0	17.1	14.7	34.9
NO_3	(weight-%)		1.0	7.1	8.5	13.5
Cl	(weight-%)		—	0.2	0.2	0.2
Other	(weight-%)[d]		1.0	—	—	0.9
Decay Heat Generation Rate Range (W/m^3)		309-412	35-100	50-75	45-55	1-30
Bulk Density (g/cm^3)		1.76-1.84	1.4		—	1.44
Thermal Conductivity (W/m-°K)		0.19	0.14 @ 38°C 0.52 @ 138°C	—	0.29 @ 100°C	0.19

— = Negligible value
a = NWCF H-3 campaign values
b = NWCF H-4 campaign typical blend values
c = Expected values from NWCF high temperature calcining operations, based on composite analysis of all sodium bearing waste tanks
d = Undissolved solids and other minor species present in the INTEC Tank Farm waste.

The majority of the existing and proposed waste contains high levels of sodium. In the past, the Na+K content was limited to 5.3 mole-%.[17] Laboratory studies indicate that if the Na+K content is 11.5 mole-% or lower,[22] for Tank Farm feed calcined at a nominal operating bed temperature of 932°F (500°C), then the calcine is retrievable. If the Na+K content is 17.4 mole-% or lower,[23] for Tank Farm feed calcined at a nominal operating bed temperature of 1,112°F (600°C), then the calcine is retrievable. These results are from conclusions based on retrieval tests of pilot plant calcine. Calciner pilot plant tests using a higher Na+K content resulted in agglomeration problems during calcination, such that calcine could not be generated for retrieval tests. The results of the retrieval studies are based on a maximum calcine storage temperature of 572°F (300°C) and a maximum decay heat generated rate of 12.7 Btu/ft^3-h (131 W/m^3).

The feed to the NWCF is controlled by the run plan to ensure the retrievability of the calcined solids. Laboratory studies[22,23] indicate successful retrievability of the calcined solids with vibrator assistance at bin storage conditions of 572°F (300°C) and 15.3 psig (105.4 kPag). In addition, these studies assume that only natural convection cooling is available. Therefore, the Sixth CSSF blowers are not required to be operable during NWCF calciner operations. Typical properties of calcined solids are summarized in Table 2-1.

2.3.4 Decommissioning

The Sixth CSSF is designed for the safe removal of the calcined solids for final D&D of the Sixth CSSF. Leakage of the calcined solids from a bin or fill line is not expected. However, if a calcined solids spill does occur, the interior vault concrete surface may become contaminated, complicating final D&D efforts.

It is anticipated that final D&D efforts will consist primarily of retrieving the bulk of calcined solids from the bins by inserting a retrieval system through the retrieval access lines. Any residual radioactive solids on the bin walls then may be removed by inserting decontamination nozzles through a retrieval access line and spraying the walls with a decontamination solution. The residual liquid can be removed with a jet inserted into a retrieval access line. Final D&D by direct contact may be required for the last cleanup phase and necessitate personnel entry into the Sixth CSSF vault.

If the calcined solids agglomerate, the current retrieval system may not be adequate for the final D&D of the Sixth CSSF. Therefore, it may be necessary to wait until (1) the radiation fields decay to acceptable levels for entry into the vault and bins or (2) more sophisticated removal systems or techniques are developed. Removal of the calcined solids is not covered by this safety analysis. Final D&D activities, which include calcined solids removal, require a separate safety analysis for the Sixth CSSF.

2.4 Facility Structure

2.4.1 Location and Facility Layout

The Sixth CSSF is located within the INTEC boundaries, just east of the NWCF. Figure 1-1 identifies the location of the Sixth CSSF with respect to the other INTEC facilities and features, including roadways, railroad lines, and wells. Figure 2-2 shows each of the INTEC CSSFs with respect to the NWCF.

2.4.1.1 Site Boundary. The INTEC boundary lines are shown in Figure 1-1.

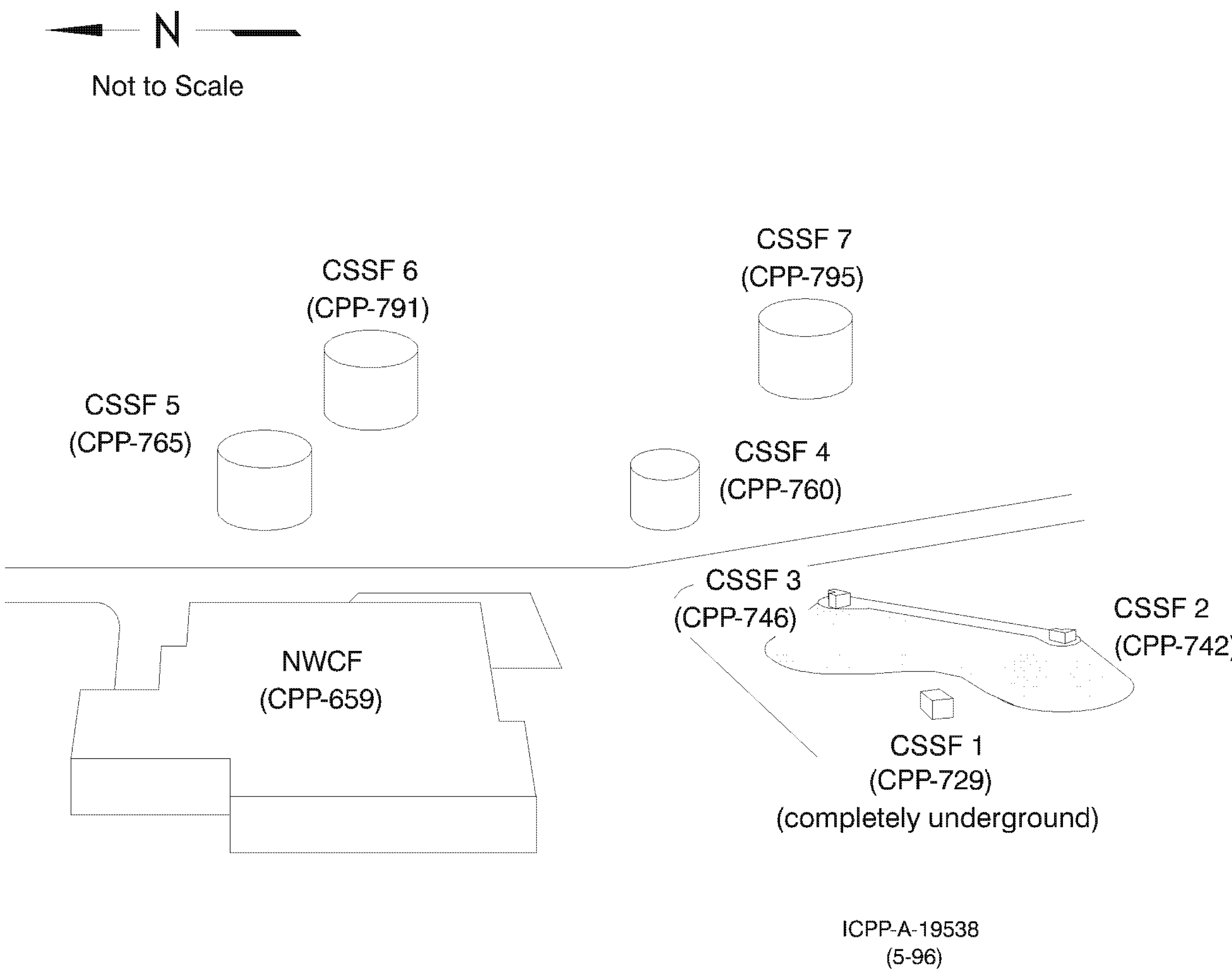

Figure 2-2. The NWCF and CSSFs.

2.4.1.2 Restricted Area. The INTEC restricted area is encompassed by the INTEC outer fence, as indicated in Figure 1-1.

2.4.1.3 Site Utility Supplies and Systems. Electrical, compressed air, and steam utilities for the Sixth CSSF are supplied by the NWCF distribution system. A detailed discussion of the utility systems is provided in subsection 2.8 of this safety analysis.

2.4.1.4 Storage Facilities. The Sixth CSSF is a storage facility for calcined waste. No auxiliary storage facilities are included or required for the Sixth CSSF.

2.4.2 General Description

The Sixth CSSF operation is a simple, passive operation, similar to the operation of the First through Fifth CSSFs. The solids produced in the NWCF calcining process are transported pneumatically from the calciner vessel to the Sixth CSSF cyclone separator located above the stainless-steel bins. The cyclone separates the solids from the air, and the air is returned to the calciner where it is processed with other NWCF off-gases and then released to the environment via the INTEC Main Stack.

The calcined solids, separated from the transport air in the cyclone, drop to a fill distributor where they are channeled to the seven storage bins. The transport system and bins operate at a vacuum. An NWCF return jet adjusts this vacuum for normal calcined solids-transport and calciner bed removal.

During storage, the decay heat generated from the stored solids is removed from the bins by convection cooling and a combination of conductive and radiant heat transfer through the vault walls to the soil. The inlet vault cooling air is drawn through a roughing filter to the bottom of the vault. This air then flows up the sides and annuli of the bins where heat transfer occurs. The air is finally discharged through the effluent vault cooling air stack by natural or forced convection.

The effluent vault cooling air is monitored continuously in the exhaust plenum room by a continuous air monitor (CAM). The CAM is capable of detecting gross beta and gross beta-gamma particulate concentrations. If the airborne radioactive particulate exceeds the CAM setpoint, the vault cooling air filtered discharge system automatically (1) closes the exhaust plenum room damper, (2) diverts the air through a parallel system of high-efficiency particulate air (HEPA) filters located in the fan room, and (3) starts the fan room blowers.

Analysis indicates that calcined solids with a decay heat generation rate of 12.7 $Btu/ft^3 \cdot h$ (131 W/m^3) can completely fill the bins during the NWCF H-4 campaign with natural convection cooling only.[23] According to the thermal analysis, structural constraints are not violated nor do the calcined solids agglomerate if the unfiltered blower, located in the exhaust plenum room, is not used. After the bins are filled, and the decay heat generation rate remains low enough for conduction through the vault walls to prevent exceeding various design temperatures, the vault cooling air can be isolated permanently.

Each bin is vented to a common off-gas line at all times. This common vent line discharges air through the two bin vent off-gas HEPA filters and then to the exhaust plenum room where the bin vent off-gas mixes with the effluent vault cooling air. This line contains two pressure relief valves and a single vacuum relief valve. An in-line rupture disk is installed between the bins and the relief valves (see Figure 2-3). The rupture disk prevents migration of radioactive particulate to the vacuum and pressure relief valves.

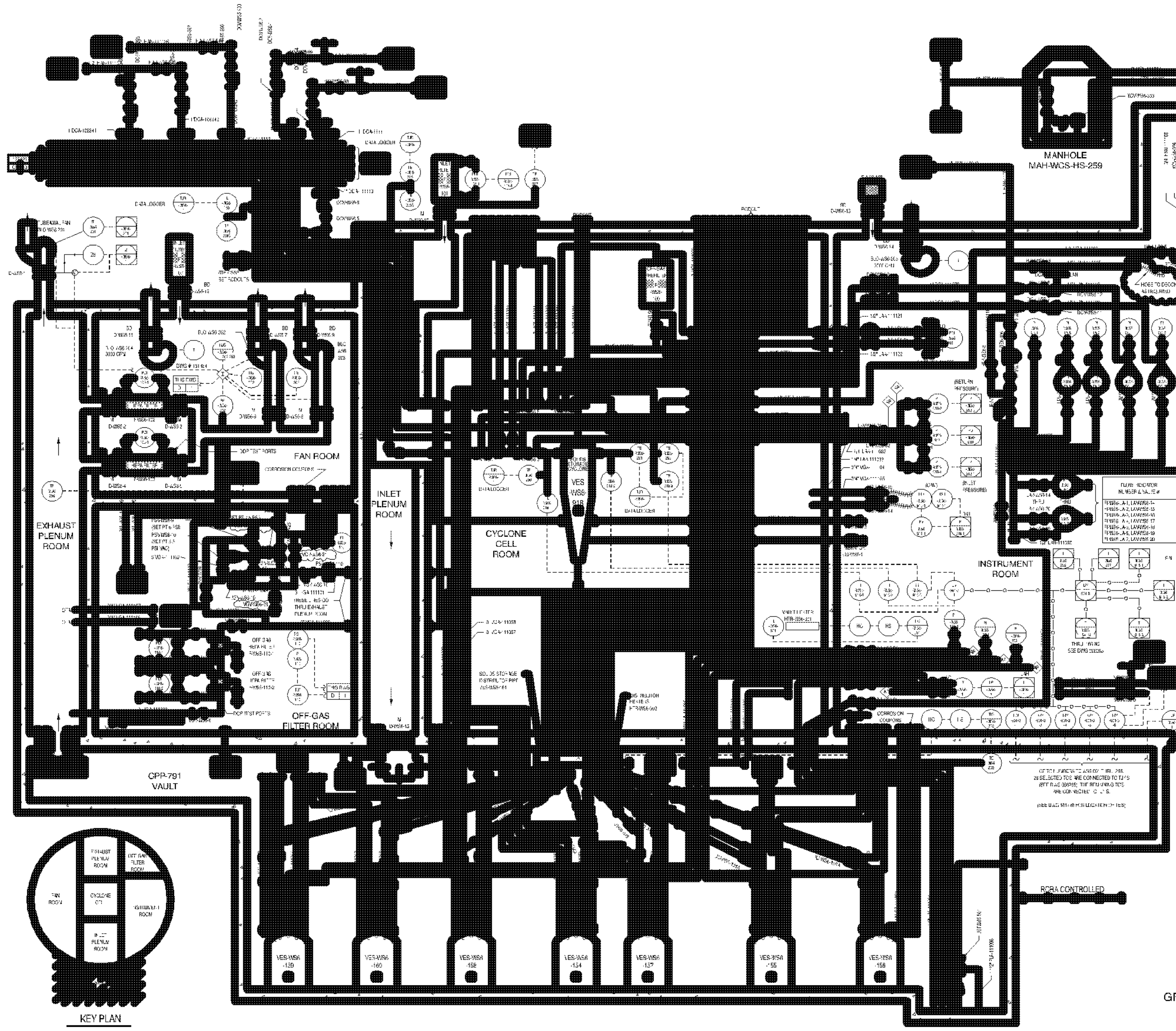

Figure 2-3. The Sixth CSSF bin vent schematic.

This maintains the philosophy of as-low-as-reasonably-achievable (ALARA) radiation exposure in the event that any of the relief valves require maintenance or replacement.

2.5 Process Description

2.5.1 General Layout

The functional features of the Sixth CSSF are shown in Figure 2-1. The Sixth CSSF consists of a lower and upper level, roof, and external components. Utility piping and electrical conduits for the Sixth CSSF are provided for high-pressure steam, condensate, high-pressure air, electrical power, instrument signals, vault sump, and bin vent off-gas.

2.5.1.1 Lower Level Description. The lower level of the Sixth CSSF consists of the bin storage vault, which contains the seven annular stainless-steel bins. This vault is cylindrical and built with reinforced concrete.

2.5.1.2 Upper Level Description. The upper level of the Sixth CSSF contains the instrument, cyclone cell fan, off-gas filter, and inlet and exhaust plenum rooms. A wall separates the instrument room from the fan room. This arrangement minimizes the possibility of contamination from the various filters and reduces the heating for the instrument room.

The instrument room is isolated from the bin storage vault and contains a blower to remove heat. In 1995, it was discovered that when the instrument room blower was operating, a reverse airflow was created. This resulted in air being pulled from the bin storage vault, (a potentially radiologically contaminated area), to the instrument room, (a radiologically clean area). Therefore, the power to the instrument and fan room blowers was disconnected, and the hatches to the bin storage vault were sealed to prevent an inadvertent release of radiological contamination in the event of a calcined solids release.[24] The instrument and fan room blowers are not required for safety. Any future operation of the blowers requires physical reconfiguration and appropriate engineering re-evaluations, procedures, and management approval. The instrument room also contains a space heater. Welding and 110 V outlets are provided for maintenance activities and installation of retrieval lines.

The cyclone cell room heating system maintains the temperature of the cyclone and associated piping during filling operations. The heaters are controlled from the instrument room. The cyclone cell room is continuously monitored for airborne radioactive particulate. The walls, floor, and ceiling in the cyclone cell room are smooth-finished and painted to facilitate final D&D. All penetrations in the floor and walls of the cyclone cell room are sealed to prevent water from exiting during D&D activities. The floor of the cyclone cell room slopes toward a sump.

A large hatch for maintenance and personnel access is provided above the cyclone cell room. A smaller viewing port is located in this access hatch for visual inspections. This viewing port is located for optimum viewing of the cyclone cell room.

The vault and instrument room are designed to support (1) 70,720 lb (32,000 kg) distributed over the central 16.7 ft^2 (1.5 m^2) of the vault roof and (2) 110,500 lb (50,000 kg) distributed over 8.22 ft^2 (0.74 m^2) of the circumference located 1.0 ft (0.3 m) from the edge of the vault roof. These loads include the design weight of future retrieval systems.

2.5.1.3 Roof Description. Located on the roof of the Sixth CSSF are three air exhaust stacks, the inlet air housing, the 3,978 lb (1,800 kg) and 5,967 lb (2,700 kg) jib cranes, the equipment building, the handrail, and the access doors to the fan room.

2.5.1.4 External Description. Located on the outside of the Sixth CSSF are the stairway, access door, concrete shielding for the transport air and steam lines, and the caged-hoop emergency ladder.

External penetrations are located above the anticipated flood level and include access hatches, electrical power, retrieval access lines, inlet air ducting, gas sample lines, exhaust ducting, decontamination lines, hatches for corrosion coupons, condensate lines, and inspection ports.

2.5.2 Bin Storage Vault

The bin storage vault system consists of the vault structure, vault cooling air system, and vault leak detection system.

2.5.2.1 Vault Structure. The vault surrounding the bins is a reinforced concrete, waterproof structure, approximately 112 ft (34 m) high with a 61-ft (18.6-m) diameter. The vault is built on bedrock and is partially buried with backfill. The vault structure is designed to withstand the DBT, DBE, and DBF. All penetrations are at least 2 ft (0.6 m) above the expected water level of 4,916.6 ft (1,499 m) for the probable maximum flood. The structural design conforms to the applicable standards that existed when the vault was designed and built. These criteria included:

1. General Design Criteria Engineering Handbook[25]

2. U.S. Department of Energy, Idaho Operations Office (DOE-ID), Operational Safety Design Criteria Manual DOE-ID-12044[26]

3. DOE Order 5480.lA[27]

4. INEEL Architectural Engineering Standards[28]

5. Exxon Nuclear Idaho Company, Inc. (ENICO), ENICO Supplement to DOE-ID Architectural-Engineering Standards for the INEL[29]

6. DOE-ID Appendix 0550.[30]

2.5.2.2 Vault Cooling Air. The vault cooling air system is designed to prevent the bins and calcined solids from exceeding specified temperature limits. Decay heat is removed by natural- or forced-air cooling, depending upon the amount of heat being generated. Normally, the vault cooling air is discharged unfiltered and is isolated from the environment after convection cooling is no longer required. The vault cooling air system also prevents airborne radioactive particulate from reaching the environment. This system comprises the inlet, effluent, and filtered discharge systems.

The vault cooling air system removes decay heat from the storage bins, if necessary, by passing filtered, outside air up the sides and center of the bins. The ducting design allows natural convection flow to occur. A forced-convection blower is available to draw air from the vault and discharge it unfiltered through the exhaust stack if the airborne radioactive particulate limit is not exceeded. If the airborne radioactive particulate exceeds this upper limit, the effluent vault cooling air is drawn by one of two blowers through two parallel HEPA filter banks before the cooling air is discharged to the environment.

The other blower is used as a backup, and it automatically starts upon failure of the operating blower. Both blowers and the HEPA filters are located in the fan room.

Three separate effluent vault cooling air stacks are provided for the Sixth CSSF. The unfiltered vault cooling air discharge stack is 40.0 ft (12.2 m) high. The other stacks are each 20.0 ft (6.1 m) high and are located on the two filtered discharge system blowers. Only one of the three stacks is in service at any time.

2.5.2.2.1 Inlet Vault Cooling Air—The inlet housing on the Sixth CSSF roof draws cooling air into the vault. The inlet is equipped with filters to minimize the introduction of dirt or foreign matter into the vault. The inlet has a manual damper to permit isolation when convection cooling is no longer necessary.

The fresh air moves in carbon-steel ducts to transition pieces, and finally through 304L stainless-steel ducts. The stainless-steel ducts are located at the bottom of the vault. Each duct separates into three distributors for release of the air at the base of the bins. Convective currents distribute the air within the vault and among the seven storage bins. The base skirts have openings to allow airflow through the central opening in the annular bins.

Temperature elements on the inlet measure the air temperature after the air passes through the inlet vault cooling air filters and dampers. These temperatures and the inlet air pressure are relayed to indicators mounted on a panel in the Sixth CSSF instrument room.

2.5.2.2.2 Effluent Vault Cooling Air—The heated effluent vault cooling air rises to the top of the vault and exits to the environment via the exhaust plenum room. If necessary, the in-line blower is available for cooling of the bins. This blower is located outside of the exhaust plenum room.

2.5.2.2.3 Filtered Discharge System—The vault cooling air filtered discharge system remains operable until the vault cooling air is permanently isolated from the environment. Filtration is provided if airborne radioactive particulate is detected in the effluent vault cooling air. A CAM in the instrument room draws an air sample from the exhaust plenum room and measures the airborne radioactive particulate in the effluent vault cooling air. The information is recorded on the CAM and sent to the NWCF distributed control system (DCS). If the airborne radioactive particulate exceeds the specified setpoint, the signal (1) activates alarms in the Sixth CSSF instrument and NWCF control rooms, (2) closes the exhaust plenum room damper to prevent unfiltered air from being discharged to the atmosphere, and (3) starts one of the two fan room blowers to draw the effluent vault cooling air through the two filtered discharge system HEPA filters.

The blowers associated with the filtered discharge system are redundant. The standby blower starts automatically if the operating blower fails. The filtered discharge system blowers and natural circulation ensure that airflow in the vault is always available, except during a simultaneous loss of commercial and standby power. The vault cooling air filtered discharge system blowers can be used as a backup to the exhaust plenum room blower if a mechanical failure or loss of power occurs. The blower design allows for easy blower replacement. Each blower is capable of maintaining a vacuum in the vault. The blowers have a performance flow rate of approximately 473.3 ft^3/s (14.2 m^3/s).

Locally mounted instruments measure the differential pressure across each HEPA filter bank. The HEPA filters in the fan room are tested per approved procedures. Use of the HEPA filters ensures that a spill inside the vault does not allow contamination spread to the environment. The vault cooling air filtered discharge HEPA filters are designed for in-place testing of the filters. These filters are of a bagout design and have a fluid seal. They have a minimum filtration efficiency of 99.97% for 0.3 micron diameter particles.

A damper position indicator in the Sixth CSSF instrument and NWCF control rooms shows the position of the exhaust plenum room damper. If either of the filtered discharge system blowers is operating, the damper for the exhaust plenum room is closed, and the intake and exhaust dampers for the operating blower are open. Two sample taps are provided in the filtered discharge system exhaust ducts just upstream of the filtered discharge system blowers and downstream of the HEPA filters.

2.5.2.3 Vault Leak Detection. Liquid leakage into the Sixth CSSF vault is directed to the vault sump. The liquid level of the sump is monitored on the instrument room panel and in the NWCF control room. Alarms are actuated in the Sixth CSSF instrument room and NWCF control room if the high liquid level in the sump is reached.

2.5.3 Storage Bins

The bins provide the primary containment for the radioactive solids during the design lifetime (approximately 500 years) of the facility. Each bin is cylindrical with an annulus designed to permit upward airflow cooling of the bin centerline. The seven annular bins receive the calcined solids from the NWCF transport system. The storage bins and piping were fabricated and inspected in accordance with applicable codes and standards. Adequate heat transfer is ensured by the bin shape, bin support structures, and the vault cooling system.

2.5.3.1 Structures and Components. Each storage bin is functionally equivalent and differs only in corrosion testing and instrumentation. The bins are connected in parallel to the Sixth CSSF calcined solids distributor system. Each bin is designed to the requirements of the ASME Boiler and Pressure Vessel Code.[10] The bins are 68 ft (20.7 m) high, annular in shape, with an inside diameter of 13.5 ft (4.1 m), and an inside diameter of 5 ft (1.5 m). Approximately 7,643 ft^3 (216 m^3) of calcined solids can be stored in each bin. The design pressure for each bin is 8.5 psig (58.6 kPa-gage), and the design vacuum is 6.5 psig (44.8 kPa-gage). The rupture disk and relief valve settings are within the design criteria specified for the bins.

The spacing between bins and between the bins and vault walls provides adequate cooling airflow for the bins during and after filling. The design temperatures for the bin walls, supports and anchors, and attached piping in the vault were determined by thermal analysis using the vault cooling air requirements and the maximum allowable peak calcined solids temperature specified in the design criteria.[13] The bins are designed to withstand wall temperatures of 500°F (260°C). The temperature distribution was determined by thermal analyses.[19] Structural analyses included the sum of the thermal stress, pressure, and dead weight for the bins and calcined solids.[13,14]

Each bin is supported by and anchored to the vault floor with stainless-steel bolts. The base-ring skirt that supports each bin is ventilated to allow the vault cooling air to circulate up each bin annulus. The bins do not contain internal bracing or equipment other than corrosion coupons and thermocouples.

The bins, attached vault piping, supports, and anchors are fabricated of stainless steel. The bin wall corrosion thinning allowance is 0.02 in. (0.05 cm) for the bin-life total reduction. This total corrosion allowance is sufficient for 500 years under normal atmospheric conditions. A corrosion allowance of 0.010 in. (0.025 cm) for the bin interior was obtained by extrapolating observed corrosion of coupons from the other CSSFs and adding a safety factor of 0.004 in. (0.010 cm). A corrosion allowance of 0.010 in. (0.025 cm) for the bin-exterior was obtained from literature.[31,32]

Two of the bins contain five cables from which corrosion coupons are attached. For each of these two bins, a 6-in.-diameter pipe is available for coupon retrieval. These pipes are blind-flanged after the coupons are installed. The bottom inlet to the retrieval pipe is designed to prevent snagging of the coupons when retrieved. Roof hatches are supplied for pulling the cables. The coupon retrieval lines are separate from the calcined solids retrieval access lines. In addition, corrosion coupons are installed in one of the inspection ports for future retrieval and inspection.

2.5.3.2 Transport and Filling Systems. The transport system pneumatically transfers the calcined solids from the NWCF to the Sixth CSSF. The fill system separates the calcined solids from the transport air and distributes them to the storage bins. After the solids are separated, the transport air is returned to the NWCF calciner. The piping, valves, and cyclone vessel are fabricated to applicable codes and standards. Rod-out lines are available to remove any plugging that may occur in the various piping.

The transport and filling systems include the transport lines, a spare transport line, a cyclone, a solids distributor, stubs to connect future lines, sampling connections, and two fill lines per bin. The following subsections describe the transport lines, cyclone, and solids distributor.

2.5.3.2.1 Transport Lines—This system includes the product transport air line, transport air return line, spare transport line, steam tracing line, and encasement. The calcined solids are transferred pneumatically from the NWCF to the cyclone cell room via the product transport air line. The transport air is returned to the NWCF in the transport air return line. The transport lines and encasement are sloped toward the NWCF for D&D. The number of bends is minimized, and all bends use blinded tees. The product transport air and transport air return lines are covered with backfill and supported to meet DBE criteria. Rod-out lines are provided for the transport lines.

The nominal pipe diameters are 3 in. The straight sections of the product transport air line outside the Sixth CSSF and the entire transport air return line are Type 304L stainless steel. All 90-degree bends in the product transport air and spare transport lines are Nitronic 50 stainless-steel blinded tees with a 3/4-in.-thick Nitronic 50 stainless-steel reinforcing sleeve. These pipes are Nitronic 50 stainless-steel for approximately 6.0 ft (1.8 m) downstream and 1.5 ft (0.5 m) upstream of each tee.

The product transport air line connects to existing stubs from the main trunk line that also is connected to the Fourth, Fifth, and Seventh CSSFs. The trunk line has stubs for future expansion of the product transport air line extension, transport air return line, spare transport line, steam tracing line, and the encasement. The product transport air line extension, transport air return line riser extension, and spare transport line extension each have a decontamination line with a 1-in. diameter extending to the surface of the ground. The decontamination lines have air-purge capability through a permanent valving and piping arrangement.

The transport lines are encased in a common Schedule 10 stainless-steel pipe buried 10.0 ft (3.0 m) belowgrade. The encasement is all-welded construction. An allowance for thermal expansion is designed into the encasement piping to protect the shielding concrete. A valved and blind-flanged encasement sampling line, with a 1-in. diameter, is connected to the encasement and terminates inside the instrument room.

The encasement contains a Type 304 stainless-steel steam line. The line is designed to maintain the temperature of the transport lines. Two thermocouples are located in the encasement to monitor the temperature. To obtain a representative temperature, additional thermocouples are located in the valve yard between the NWCF and the Sixth CSSF.

The concrete shielding [approximately 3.1 ft (0.9 m) thick around the encasement] assumes that the product transport air, spare transport, and transport air return lines are coated with 1/16 in. (0.16 cm) of calcined solids. The allowable radiation dose rate limits for these lines are (1) 1.25 mR/h for the section entering the Sixth CSSF, (2) 7.5 mR/h for the belowgrade section, and (3) 0.5 mR/h for the abovegrade section. The 10.0 ft (3.0 m) of earth cover is used to reduce the field to 0.5 mR/h at grade.

2.5.3.2.2 Cyclone—The cyclone design pressure is 30 psig (207 kpa-gage) at 300°F (149°C) with a gas flow of 65 to 85 scfm at 8.5 psia (160.6 kPa), a pressure drop of 4 in. w.c., and a nominal solids load of 275 lb/h (125 kg/h). The peak solids load occurs during bed unloading at 1,000 lb/h (454 kg/h). The minimum cyclone collection efficiency for calcined solids with a particle density of 144 lb/ft^3 (2.3 g/cm^3) is 40% for 2 micron diameter particles, 90% for 5 micron diameter particles, and 99% for 100 micron diameter particles.

The cyclone is constructed of Nitronic 33 stainless steel, American Society for Testing and Materials (ASTM) grade XM-29, and Nitronic 50 stainless steel, ASTM grade XM-19. The original design total-lifetime corrosion and erosion allowance was 0.300 in. (0.76 cm) for the inside and outside of the inlet region, 360 degrees around the vertical axis. However, additional wear pads were installed in 1985 and 1987 for a total thickness of 1.290 in. (3.31 cm).[33,34] The new total-lifetime expected wear is 1.040 in. (2.67 cm) because of the expected blinded configuration and use of the less erosive Na+K blend. Otherwise, the total-lifetime corrosion and erosion allowance is 0.125 in. (0.32 cm).

The cyclone is equipped with a pneumatic vibrator to loosen solids from the cyclone. A rod-out line extends from the top of the cyclone to the roof of the Sixth CSSF.

2.5.3.2.3 Solids Distributor Design Description—The calcined solids fall by gravity from the cyclone into the distributor. The distributor feeds the bin fill lines. The distributor is heated and has a thermocouple readout in the instrument and NWCF control rooms. Rod-out lines, each with a 2-in. diameter, are provided for unplugging the distributor and fill lines. Each rod-out line extends to the top of the cyclone cell room roof. These lines are flanged at the top and have a shielding cap. Only long radius bends of 1.5 ft (0.46 m) or greater are used for the distributor and fill lines to prevent plugging.

Each bin has two 3-in.-diameter fill lines for distributing the calcined solids on opposite sides of the bin annulus. The lines are sloped at a minimum of 45 degrees. Each fill line has expansion joints for thermal expansion caused by the decay heat generated by the calcined solids. All piping is made of Type 304L stainless steel.

The connections for the main transport line from the NWCF are saddle tees placed at angles for direct routing to the Sixth CSSF. Nitronic 50 stainless-steel reinforcing sleeves are provided on this piping for a minimum of 1.5 ft (0.46 m) downstream of these connections. Using Nitronic 50 stainless-steel blinded tees and reinforcing sleeves on the angle junctions increases erosion resistance, thus decreasing the possibility of breaching a transport line.

2.5.3.3 Retrieval System. At the top of each bin are four retrieval access nozzles designed to provide access for an external retrieval system. These nozzles have an 8-in.-diameter pipe and are equally spaced around the outer annulus of each bin. Attached to the retrieval access nozzles are 8-in.-diameter pipes that form the retrieval lines. These lines are straight and vertical, located halfway between the inner and outer wall of the bin. The sections of the retrieval lines that pass through the cyclone cell room are shielded with 3/4 in. (1.9 cm) of lead. Retrieval lines for the six outer bins terminate in the floor of the rooms located in the vault second floor. They are flanged and have a metal cover and lead shielding plug. Extensions are attached if access to the retrieval system is required.

2.5.3.4 Bin Vent Off-Gas Filter System. The bin vent off-gas filter system provides underpressure and overpressure protection during bin filling or normal calcined solids storage. This protection prevents breaching of the storage bins. The bin vent off-gas system provides passive pressure equalization of the bins with the atmosphere when the transport air lines are closed.

The major components of the bin vent off-gas filter system include the vent piping, prefilter, bin vent valve, HEPA filters, and relief system. The majority of the vent piping is located in the bin storage vault and the cyclone cell room. The off-gas HEPA filters and relief system are located in the off-gas filter room. The prefilter and bin vent valve are located in the cyclone cell room.

2.5.3.4.1 Piping—Each bin has a Type 304L stainless-steel vent pipe connected directly to the top of the bin. The bin vent pipes join a common header connected to the off-gas HEPA filters and relief system, and when required, the off-gas prefilter.

The piping and valves were fabricated, assembled, and inspected to applicable codes and standards in place at the time of construction of the Sixth CSSF. The piping attached to the bins and located within the vault is designed to withstand the heat stress caused by the thermal displacement of the bins from 14° to 500°F (-10° to 260°C). The piping in the cyclone cell room is shielded with 3/4 in. (1.9 cm) of lead.

2.5.3.4.2 Off-Gas Prefilter—During filling operations, the off-gas prefilter is isolated from the bins and transport system to prolong the life of the filter. When filling operations are not conducted, the NWCF transport air line valves are closed, the Sixth CSSF bin vent off-gas prefilter is placed into operation, and the bins are vented through the off-gas prefilter and HEPA filters.

The off-gas prefilter is located in the cyclone cell room upstream of the bin vent off-gas HEPA filters. In addition, personnel radiation exposure is minimized by the prefilter because it assists in preventing the migration of radioactive contaminants when the off-gas HEPA filters are replaced.

2.5.3.4.3 Bin Vent Valve—During filling operations, the off-gas prefilter is isolated from the bin vent system by closing bin vent valve TAV-WS6-1. It is physically located in the cyclone cell room, but it is remotely operated from outside of the cyclone cell room. This valve is opened whenever the transport system is isolated: normally during NWCF shutdowns or when the Sixth CSSF bins are operationally full.

2.5.3.4.4 HEPA Filters—The bins normally are vented through two off-gas HEPA filters in series located in the off-gas filter room. The operating limits for the bin vent off-gas HEPA filters are (1) a maximum pressure drop of a 10-in. w.c., (2) a maximum radiation dose rate level of 5 R/h on contact, and (3) a current filter aerosol test. The discharge line from the bin vent off-gas HEPA filters includes a sample line.

The discharge of the bin vent off-gas HEPA filters is routed near the exhaust plenum room CAM sample line to detect an airborne radioactive particulate release caused by a bin vent off-gas HEPA filter breach. Butterfly valves are located on the inlet and discharge of the bin vent off-gas HEPA filters for isolation of the filters prior to replacement.

2.5.3.4.5 Relief System—The Sixth CSSF relief system protects the bins from excessive pressure and vacuum. The system design accounts for the resultant vacuum or pressure of the bins caused by abnormal operating conditions, such as plugging of the product transport or return air lines.

A rupture disk is located between the bins and the relief valves (see Figure 2-3). The rupture disk is not a safety device designed to prevent excessive vacuum or pressure of the bins. The rupture disk serves as a barrier to prevent migration of radioactive particulate to the relief valves and the filter room piping under normal operating conditions. This limits personnel radiation dose exposures during relief valve calibration and maintenance. All off-gas filter room piping, upstream of the rupture disk, is shielded from radiation.

The pressure relief valve set at 6.0 psig (41.4 kpa-gage) and the high pressure relief valve set at 7.5 psig (52 kpa-gage) discharge to the bin vent off-gas HEPA filter line. The vacuum relief valve is set at a negative pressure of 5.5 psig (37.9 kpa-gage) to draw the bin vent air through the off-gas HEPA filters. The rupture disk is designed to rupture before the bin pressure and vacuum exceed 6.0 psig (41.4 kPa-gage). The pressure gage is located in the off-gas filter room. Isolation valves are provided for calibrating the relief valves in place for periodic calibration. The pressure gage is located in the off-gas filter room. Isolation valves are provided for calibrating the relief valves in place for periodic calibration.

2.5.4 Instrumentation and Control Systems

The Sixth CSSF includes instruments for monitoring various facility parameters, including temperatures, pressures, and airborne radioactive particulate. The instrument and control systems associated with the Sixth CSSF are provided in INTEC Drawing No. 161425.

2.5.4.1 General. Most instrument readouts are located in the Sixth CSSF instrument room or in the NWCF control room. These instruments can be temporarily removed from service for testing and calibration. Many of the Sixth CSSF instruments only have local readouts. The instruments that are required to be continuously monitored, such as system temperatures, pressures, levels, and differential pressures, are located on the DCS in the NWCF control room. All components inside the Sixth CSSF bin storage vault are resistant to a maximum total radiation exposure of 10^{10} R. All elements, gages, transmitters, and controllers located outside the vault and cyclone cell room are capable of being calibrated, tested, and maintained.

Transmitters for the Sixth CSSF are located in the instrument room. This placement allows for maintenance to be performed with minimal radiological controls. Indicators and recorders are selected for driving-transmitter or transducer compatibility. Therefore, individual recorders are not from the same manufacturer. Modular systems are used when possible to maximize repairs with working module replacements. Facilities for module testing and repair are available at the INTEC instrument shop.

Most of the transmitters are solid-state electronic devices with minimal mechanical linkages and other moving parts. The electronic-type transmitters are contained in watertight, moisture-proof, corrosion-resistant housings. A two-wire type design is incorporated. The operating voltage for the transmitters is 24 V (dc). Test jacks are provided for each transmitter to aid in maintenance and calibration activities at the transmitter boxes. Transmitter electronics provide for rapid field repair because of the modular, easily replaceable components. The disabling of other transmitter signals to repair electronics is not required.

Pneumatic transmitters are connected to the process variable with stainless-steel tubing. However, copper tubing is used in the instrument room. Each pneumatic transmitter has a stainless-steel, five-valve manifold.

The following alarm and readout indicators are connected to the DCS in the NWCF control room:

1. Cyclone differential pressure
2. Transport air pressure exiting the cyclone
3. Transport air and air return line temperatures
4. Cyclone surface temperature
5. Cyclone cell room airborne radioactive particulate
6. Effluent vault cooling air airborne radioactive particulate
7. Exhaust plenum room damper position
8. Vault sump liquid level.

The following indicators are panel-mounted in the Sixth CSSF instrument room:

1. Bin temperatures
2. Vault wall and air temperatures
3. Transport system temperatures
4. Bin pressures
5. Cyclone cell room temperatures
6. Cyclone differential pressures
7. Distributor temperatures
8. Cooling air inlet and outlet temperatures
9. Cyclone surface temperatures
10. Cyclone cell and exhaust plenum rooms airborne radioactive particulate
11. Effluent vault cooling air damper position
12. Sixth CSSF electrical use
13. Operating blower flow
14. Vault sump liquid level.

The following indicators are mounted locally, adjacent to the equipment being monitored:

1. Off-gas HEPA filter differential pressures

2. Air purge pressures and flows.

2.5.4.2 Radioactive Particulate. Airborne radioactive particulate in the cyclone cell and exhaust plenum rooms is monitored. These indicators and the position of the exhaust plenum room damper ensure that unacceptable levels of airborne radioactive particulate are not released to the environment. Chapter 7 of this safety analysis provides detailed information on radiation protection instruments.

2.5.4.3 Temperature. Thermocouples are installed to monitor the temperature for the calcined solids, bin walls, vault walls, cooling air, cyclone, cyclone cell room, and transport air lines. The temperature controlling and indicating instruments are selected for input impedance, current and voltage source impedance, and circuit isolation to minimize interaction between these instruments. All in-vault and in-cyclone cell room components of the temperature measuring system can withstand a maximum total radiation exposure of 10^{10} R. The instruments are connected to standby power in the event that commercial power is unavailable. Redundant indicators are used as appropriate. In addition, appropriate indicators are available in the event that commercial power is lost.

Chrome-alumel thermocouples are used as temperature sensors. Sheathed, polyamide-insulated thermocouples are used to obtain highly reliable temperature measurements. The thermocouples are routed from the vault through pull boxes and conduit. Signals are sent to a multipoint temperature recorder and selected ones are sent to the DCS and individual temperature controllers.

The cyclone surface temperature and the Sixth CSSF-calcined solids transport air line temperatures are monitored. These temperatures provide an indication of steam-tracing adequacy and problems that may occur during the calcined solids transfer process. The cyclone and distributor are temperature-controlled by electric heaters. Thermocouples sense these temperatures and activate the heater controllers.

2.5.4.3.1 Calcined Solids Temperature—Each bin has vertical columns of thermocouples located in the calculated maximum bin temperature zone. The thermocouples in each column are spaced 5 ft (1.5 m) apart. The two columns are on opposite sides of the bins and located as far as is feasible from the retrieval nozzles. The bin temperature thermocouples range from 14° to 1,472°F (-10° to 800°C).

2.5.4.3.2 Bin Outer Wall Temperature—Each bin has four skin thermocouples located on the outer wall.

Circumference Bins. One thermocouple is located at the bin mid-elevation facing the vault wall. The other three thermocouples are placed on the bin walls facing the vault center at the quarter, mid-quarter, and three-quarter elevations.

Center Bin. Two thermocouples are placed opposite of each other at both the mid-quarter and three-quarter elevations. The thermocouples face a circumferential bin.

Inner Annulus Wall Temperature. The inner annulus wall of each bin has six skin thermocouples located in pairs on opposite sides of the annulus at the quarter, mid-quarter, and three-quarter elevations.

2.5.4.4 Pressure. Pressure indication is provided for the bins, the transport air lines, and the vault cooling air system. Differential pressure indication is provided across the cyclone, the bin vent off-gas HEPA filters, and the filtered discharge system HEPA filters. Air lines are provided for purge flows to instrument and decontamination lines.

2.5.4.5 Miscellaneous. The vault sump liquid level is monitored. This monitor provides an indication of water leakage into the vault. An air-purged bubbler probe and differential pressure transmitter provide vault sump level indication and an alarm. Air-purge flow measurements only have local indicators. The measurements are via rotameters.

2.6 Confinement Systems

The following subsections describe the confinement systems used at the Sixth CSSF for the storage of the calcined solids.

2.6.1 Protection by Multiple Confinement Barriers and Systems

The fundamental feature for maintaining the safe operation of the Sixth CSSF is the confinement of the stored calcined solids. Confinement is achieved by a system of redundant safety barriers, instruments, filters, and operational and procedural controls. These storage control features and local seismic conditions are particularly important in the facility design.

The Sixth CSSF uses a double-containment principle to isolate the calcined solids from the environment. Both the bins and vault are designed to contain the solids in the event that the other containment is breached. Release of any calcined solids into the environment requires breaching a bin or fill line in conjunction with the subsequent leakage from the vault via breaks in the vault walls or failure of the vault cooling air filtered discharge system.

2.6.2 Bins

The seven annular storage bins provide the primary containment for the radioactive solids and are designed to the requirements of the ASME Boiler and Pressure Vessel Code.[10] Each bin is supported and anchored to withstand the DBE. The bins are contained in the reinforced concrete vault anchored to bedrock. Additional information regarding the Sixth CSSF storage bins is located in subsection 2.5.3 of this safety analysis.

2.6.3 Vault

The vault is a reinforced concrete structure approximately 112 ft (34 m) high with a 61-ft (18.6-m) diameter. The vault is a seismic Category I structure in accordance with Nuclear Regulatory Commission (NRC) Regulatory Guide 1.29.[35] The vault floor is a slab 6.5 ft (2 m) thick with a 75-ft (23-m) diameter. The vault is waterproof, and the vault excavation is back-filled to prevent water from pocketing around the vault. There are no vault penetrations at an elevation low enough to allow water infiltration even during the maximum credible flood. Required construction joints are sealed with polyvinyl water-stop. Additional information regarding the Sixth CSSF storage bin vault is located in subsection 2.5.2 of this safety analysis.

2.6.4 Vault Cooling Air Filtered Discharge System

The vault cooling air, normally discharged unfiltered through the exhaust plenum room stack, is automatically diverted through HEPA filters if the effluent vault cooling air CAM detects airborne radioactive particulate. Additional information regarding the Sixth CSSF vault cooling air filtered discharge system is located in subsection 2.5.2.2 of this safety analysis.

2.6.5 Transport Lines

Type 304L stainless-steel pneumatic transport and air-return lines are encased in welded, Schedule 10 stainless-steel pipe. Because of its superior erosion resistance, Nitronic 50 stainless steel has been used to construct all bends in the product transport supply and spare lines. The bends are blinded tees with a 0.75-in. (1.91-cm)-thick Nitronic 50 stainless-steel reinforcing sleeve. The pipe contains Nitronic 50 stainless steel approximately 6.0 ft (1.8 m) downstream and 1.5 ft (0.5 m) upstream of the tee. Additional information regarding the Sixth CSSF transport system is located in subsection 2.5.3.2 of this safety analysis.

2.7 Safety Support Systems

2.7.1 Defense-in-Depth Components and Equipment

The following design features provide safety and operational continuity for the Sixth CSSF:

1. Two parallel HEPA filter banks and two redundant blowers are part of the vault cooling air filtered discharge system. This arrangement allows maintenance for one HEPA filter and one blower without shutting down the system.

2. A rupture disk provides protection against contamination of the relief valves.

3. An installed spare transport pipe is provided to allow additional filling operations if one pipe becomes inoperable.

4. Remotely operated valves are used for the reduction of personnel radiation exposures when valve lineups are changed.

5. The instrument and fan rooms are shielded from the cyclone and bins. This arrangement reduces exposure when equipment in these rooms requires maintenance.

6. Two pressure relief valves and one vacuum relief valve in the bin vent line are provided to prevent overpressure or excessive vacuum in the bins.

2.7.2 Safety Communications and Alarms

The NWCF portion of the warning and evacuation system is supplied with normal and standby power from the INTEC electrical distribution system (EDS). A telephone is located in the Sixth CSSF instrument room.

All process alarm inputs have individual high- and low-alarm setpoints to alert the NWCF control room operators of abnormal conditions. Any high airborne radioactive particulate level alarms are activated in the NWCF control room and cause an alarm to trip in the health physics room at the NWCF.

Standby power serves the telephone system to ensure communications during emergencies. The warning and evacuation alarm and process alarm systems are also provided with standby power. Under normal operating conditions, the process alarm systems indicate the Sixth CSSF and NWCF process status.

2.8 Utility Distribution Systems

This section discusses the electrical, compressed air, and steam supply distribution systems for the Sixth CSSF. See INTEC SAR, Section 1.0, for a detailed description of the INTEC utilities.[36]

2.8.1 Electrical

Commercial power is supplied by the INEEL loop to the INTEC EDS. The INTEC EDS provides the means to deliver normal and standby electrical power to buildings, structures, and equipment. The EDS receives electrical power from the INEEL power grid Substation #2 at 13.8 kV and routes it via underground ductbanks to “distribution centers” where it is reduced to 2,400 V and 480 V for distribution to utilization loads. The Sixth CSSF uses 480 V and 120 V electrical power from the NWCF. Standby power is also provided by the 480 V line. Standby power is available for the Sixth CSSF vault cooling air filtered discharge system blowers and all instruments.

The NWCF continues to operate on standby power if normal power is disrupted. Upon both normal and standby power failures, the transfer of calcined solids from the NWCF to the Sixth CSSF is ceased. The loss of normal power results in the inoperability of the CAMs located in the exhaust plenum and cyclone cell rooms. In this case, the exhaust plenum room CAM causes the damper in the exhaust plenum room to close. Therefore, if the bins breach and calcined solids are released to the vault, the solids are confined because the vault cooling air is isolated from the environment. To ensure complete isolation of the vault cooling air from the environment during an extended power outage, a manual damper on the vault cooling air inlet can be closed.

2.8.2 Compressed Air

The compressed air distribution system supplies air to the Sixth CSSF instruments and air purges. High-pressure air at 100 psig (690 kpa-gage) is provided from the NWCF for use in the Sixth CSSF. The air enters the instrument room where it passes through a filter and a pressure-reducing regulator. The air is distributed by valves and piping to purge outlets and instrument systems. The underground air lines are provided with cathodic protection.

Air compressors that supply high-pressure air to the Sixth CSSF are connected to a standby power supply. The compressors require manual restart when normal power is transferred to the standby power bus. Therefore, the air supply to the Sixth CSSF is interrupted when normal power is unavailable.

2.8.3 Steam Supply and Distribution

Steam is supplied from the steam distribution system inside the NWCF to the Sixth CSSF. An insulated 1.5-in.-diameter line supplies high-pressure steam at a nominal pressure of 145 psig (1,000 kpa-gage) to the Sixth CSSF. This line runs underground from the NWCF to a precast concrete manhole at the base of the Sixth CSSF where a steam trap separates any condensed water from the steam. The steam line then follows alongside the outside of the storage facility where it penetrates close to the top of the Sixth CSSF concrete wall to the instrument room. The condensate line runs from the instrument room and returns via the insulated line to the manhole for removal of water. From the instrument room, the steam line is routed into the cyclone cell room and enters the 18-in.-diameter, stainless-steel encasement of the transport air and transport air return lines. The 1.5-in.-diameter, stainless-steel steam lines in the encasement assist in maintaining the temperature in the transport lines at 176ºF (80ºC). The steam supply line prevents moisture condensation and line blockage of the calcined solids in the Sixth CSSF transport lines. The vault sump jet can be operated by steam if required.

The steam distribution system contains gate and globe valves for manual isolation if a break occurs or repairs are required. A locally mounted pressure indicator is installed in the instrument room to measure the steam pressure in the system. A temporary loss of steam supply to the Sixth CSSF does not affect the storage operation. An extended period without steam may require shutdown of the Sixth CSSF until repairs are made.

2.9 Auxiliary Systems and Support Facilities

2.9.1 Process Shutdown Modes

The systems associated with the Sixth CSSF do not perform any chemical processing. Operation and shutdown of the bin filling and vent systems are dependent on the operation and production of the NWCF. The controls and isolations that prevent liquid waste or calciner heating fuel from entering the transport lines are contained and controlled within the NWCF. The transport line isolation valves are closed only during an extended shutdown of the NWCF or during required maintenance. Startup and shutdown are controlled by NWCF operations.

The vault cooling air system is designed for continuous operation during bin filling and storage of the calcined solids. Blowers and HEPA filters are replaced during filling operations by routing the air through alternate paths. The filters to the vault cooling air inlets can be replaced during operation. The vault cooling air filtered discharge system remains operational until the vault cooling air is permanently isolated from the environment.

2.9.2 Instrumentation

The Sixth CSSF instruments are discussed in subsections 2.5 through 2.8 of this safety analysis. Chapter 7 of this safety analysis provides detailed information on the radiation protection instruments.

Most instrument readouts are located in the Sixth CSSF instrument room or in the NWCF control room. These instruments can be temporarily removed from service for testing and calibration.

2.9.3 Maintenance Techniques

Most equipment that requires periodic maintenance is located in the Sixth CSSF fan, off-gas filter, or instrument rooms. This equipment includes the vault air cooling blowers, HEPA filters, and instruments. Maintenance on these items is by direct contact and conducted with proper radiological control precautions and procedures. Because the fan, off-gas filter, and instrument rooms are shielded from the cyclone cell room and storage vault, the radiation levels are minimal. An unreviewed safety question (USQ) was determined in 1995 for a reverse airflow in the instrument room from the bin storage vault. As a result, the instrument and fan room blowers were disconnected, and the access hatches to the bin storage vault were sealed to the extent possible. These actions ensure that the instrument and fan rooms are maintained as radiologically clean areas.

Remote maintenance for the equipment inside the cyclone cell room and storage vault is not planned. Minimizing total radiation exposures over the lifetime of the Sixth CSSF is accomplished by locating equipment that accumulates significant residual calcined solids, and that is relatively maintenance free, in the shielded areas. Procedures minimize the occupancy duration in high-radiation areas. When equipment cannot be removed for maintenance, portable shielding is used to minimize radiation exposure.

The rod-out of a plugged line is a potentially hazardous operation that may be required. The following items are equipped with rod-out lines accessible from the vault roof: (a) cyclone, (b) solids distributor pipe, (c) bin fill lines, and (d) transport air lines upstream and downstream of the cyclone. After the removal of the blind flange, a long tool is inserted into the appropriate rod-out line to unplug the applicable line. The contaminated rod-out tool is removed and placed in a plastic bag for decontamination or disposal. This operation is monitored by radiological control technicians (RCTs) to minimize the spread of contamination and radiation exposure to personnel. Some radiation exposure is expected during the removal and bagging of the contaminated tool.

Inspections may be required occasionally for the Sixth CSSF. Periodic vault inspections may be performed remotely via television cameras. Inspections determine the actual environment and are compared to design conditions. Procedures would be developed, approved, and followed to prevent exposure of personnel to direct radiation and to minimize contamination during inspection activities.

2.9.4 Protection by Equipment and Instrumentation Selection

Installed, redundant instruments or controls are not required for the Sixth CSSF. However, the vault cooling air filtered discharge system blowers are available if the exhaust plenum room vault cooling air blower fails.

Equipment necessary for the safe operation of the Sixth CSSF is stored at the INTEC for backup replacement. This equipment includes miscellaneous instruments, piping, HEPA filters, and miscellaneous valve parts.

2.9.5 Spent Fuel Receiving and Storage

There are no impacts on the Sixth CSSF caused by the fuel receiving and storage areas. Multiple safety protection systems are used throughout the fuel management relocation and conditioning operations and during waste calcination before the calcined solids are stored at the Sixth CSSF.

2.9.6 Radioactive Waste Treatment

No liquid waste results from the routine operation of the Sixth CSSF. If a water leak occurs, the vault water is collected in the sump.

The water is sampled and transferred to the appropriate liquid waste disposal system via the sump jet and temporary transfer lines. During final D&D, decontamination solutions can be removed through the retrieval access line via a jet. These solutions may be transferred to an evaporator or other liquid disposal system.

If airborne radioactive particulate levels require the vault cooling air to be routed through the filtered discharge system HEPA filters, and the HEPA filters fail, airborne radioactive particulate of respirable size may be released. This release does not cause any INEEL off-site environmental impact because the airborne radioactive particulate levels at the site boundary are below regulatory requirements.

The filtered discharge system HEPA filters may require changeout because of excessive pressure drops across the filters or radioactive particulate buildup. The filters are transported for disposal by approved programs and procedures.

2.9.7 Industrial and Chemical Safety

Industrial equipment used in or around the Sixth CSSF has the latest safety features that meet or exceed Occupational Safety and Health Administration (OSHA) requirements. The INTEC preventive maintenance program ensures the continued safe performance of this equipment.

Chemical hazards are minimal with the possible exception of solutions used during D&D. Chemical exposures of personnel are minimized by proper training and certification programs, regular plant maintenance, adequate shipping and handling containers, protective clothing, and operating procedures.

2.10 References

1. *Code of Federal Regulations*, Title 10, "Energy," Part 835, "Occupational Radiation Protection," Office of the Federal Register. (Hereinafter cited as 10 CFR XX.)

2. 10 CFR 72, "Criteria for Spent Fuel, High-Level Radioactive Waste Storage and Handling."

3. 10 CFR 830.120, "Quality Assurance."

4. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," U.S. Department of Energy, January 7, 1993.

5. DOE Order 414.1A, "Quality Assurance," U.S. Department of Energy, May 17, 2000.

6. DOE Order 420.1, "Facility Safety," U.S. Department of Energy, October 13, 1995 (includes changes) October 24, 1996.

7. American National Standards Institute (hereinafter cited as ANSI) Standard 14.5, "American National Standard Code for Leak Testing."

8. ANSI Standard B31.3, "American National Standard Code for Pressure Piping."

9. American Concrete Institute (hereinafter cited as ACI) Standard 349, "Code Requirements for Nuclear Safety Related Concrete Structures."

10. American Society of Mechanical Engineers (hereinafter cited as ASME), Boiler and Pressure Vessel Code.

11. American Welding Society (hereinafter cited as AWS) Standards D1.1, D1.2, and D1.4, "Structural Welding Code."

12. R. F. Mozes, Exxon Nuclear Idaho Company, Inc. (ENICO), *Project Design Criteria for he ICPP Sixth CSSF*, ENI-101, November 1979.

13. R. K. Blandford, et al., *Design Analysis of the ICPP 6th Set of Calcined Solids Storage Bins,* EG&G-RE-A-80-127, Revision 2, April 1981.

14. C. C. O'Brien, *Evaluation of Friction on Walls of Sixth Set of Bins*, EG&G Idaho, Inc., Form EG&G-2631, Engineering Design File, AMG-09-91, Revision 1, January 3, 1992.

15. R. J. Rivard, letter to B. H. O'Brien, "Typical Weight Percents for Current and Expected Calcine in CSSF 6," RJR-07-95, June 9, 1995.

16. B. H. O'Brien, letter to D. F. Reeder, "Typical Calcine Compositions for ANN/Sodium Blends for NWCF Campaign H4/H5," BHO-06-98, June 2, 1998.

17. B. A. Staples, letter to J. D. Herzog, "Composition of Calcines from H3 Campaign of the NWCF," BAS-18-94, October 21, 1994.

18. N. E. Pace, letter to R. P. Durante, "Sixth Calcine Storage Bin Set Thermal Analysis Re-review," NEP-20-91, June 25, 1991.

19. D. L. Knudson, *Sixth Calcined Solids Storage Facility Thermal Analysis*, EG&G Technical Report No. RE-A-80-091, August 1980.

20. D. R. Marshall, letter to D. F. Reeder, "Composition, Alkali Metals Mole Percents, and Heat Generation Rates of Wastes in WM-180 through WM-190," DRM-09-97, December 4, 1997.

21. H. H. Nielsen, letter to B. H. O'Brien, "Thermal Analysis of Sixth and Seventh Calcine Solid Storage Bins (CSSF) with Revised Calcine Temperature Limits," Ni-3-95, January 27, 1995.

22. T. J. Muller, letter to B. H. O'Brien, "Retrievability Study Results for Aluminum Sodium Waste Blend Calcine from 10 cm Calciner Run SBW4-46," TJM-01-95, June 9, 1995.

23. J. A. Nenni, letter D. F. Reeder, "Retrievability of Calcine Generated During High-Temperature Calcination Testing," JAN-01-98, January 12, 1998.

24. M. D. Staiger, letter to M. Dumas and J. P. Law, "6th CSSF Instrument Room Air Flow Problem," MDS-7-95, September 18, 1995.

25. Energy Research and Development Administration (ERDA), "General Design Criteria Engineering Handbook," ERDA Manual Appendix 6301, March 25, 1977.

26. U.S. Department of Energy, Idaho Operations Office (hereinafter cited as DOE-ID), *Operational Safety Design Criteria Manual*, DOE-ID-12044, January 1980.

27. DOE Order 5480.1A, "Safety of Nonreactor Nuclear Facilities," August 13, 1982.

28. DOE-ID, INEL "Architectural Engineering Standards, Revision 1," June 1, 1979.

29. ENICO, *ENICO Supplement to DOE-ID Architectural-Engineering Standards for the INEL*, December 1982.

30. DOE-ID, "Standard Operational Safety Requirements," ID Appendix 0550, September 7, 1979.

31. R. J. Schmitt and C. X. Mullen, "Influence of Chromium on the Atmospheric Corrosion Behavior of Steel," *Stainless Steel for Architectural Use*, ASTM-STP-454, pp. 124-136, 1969.

32. M. R. Jasper and H. H. Lawson, "Twenty-Year Atmospheric Corrosion Test of Stainless Steel Bars," *Stainless Steel for Architectural Use*, ASTM-STP-454, pp. 118-123, 1969.

33. S. S. Bodner, letter to K. G. Hein, "Need for Installation of Wear Pads on the Cyclones of the Sixth and Seventh Calcined Solids Storage Facilities," Bod-2-88, March 16, 1988.

34. S. S. Bodner, letter to J. G. Burton, "Erosion Evaluation of CSSF 6 and CSSF 7 Cyclones based on UT Measurements on the CSSF Cyclone," Bod-14-92, November 11, 1992.

35. U.S. Nuclear Regulatory Commission (hereinafter cited as NRC), NRC Regulatory Guide 1.29, "Seismic Design Classification," February 1976.

36. INTEC SAR, *Facility-Specific Safety Analyses*, Section 1.0, "Utilities."